Electrical World

DECEMBER 25, 1943

Featuring

POST-WAR POWER PLANT

A nation-wide analysis of objectives on twenty-six factors shaping the design of future utility fuel-burning power plants

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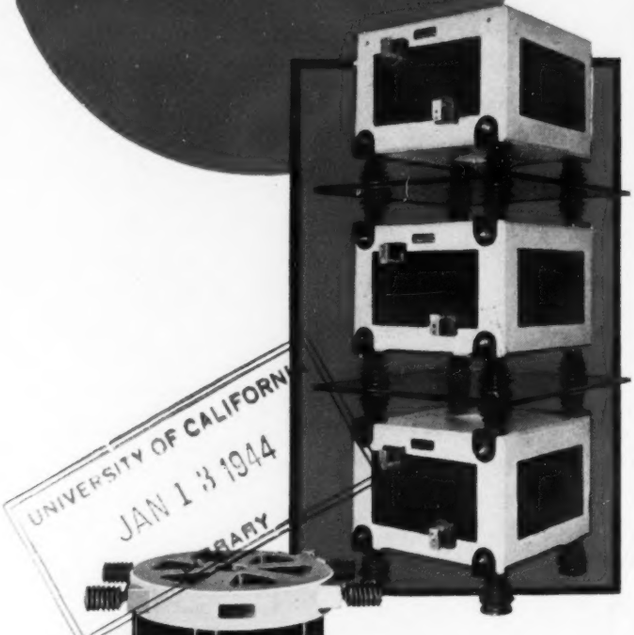
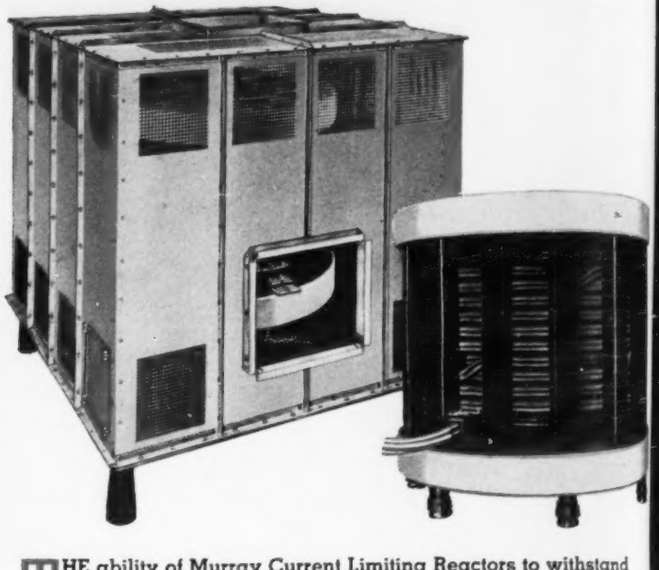
Lessen the THREAT of

power flow INTERRUPTIONS!





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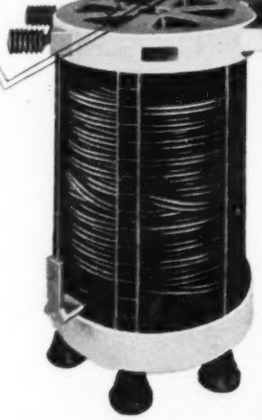

THE ability of Murray Current Limiting Reactors to withstand severe short circuit conditions is a matter of record—since the first one was built in 1910. Their reliability and sturdiness have been proved—unquestionably.

Murray Reactors are "hand-tailored" to meet definite characteristics of the particular system. And if available space for their installation is limited as in crowded plants, their size is determined to suit the conditions.

Service records of Murray Low Loss Reactors disclose the clearing of the most severe short circuits, with the resultant saving of thousands of dollars in plant equipment, maintenance and operation.

Be prepared with Murray Reactors—their installations pays and pays well.

Metropolitan Device Corporation, Brooklyn, N. Y.

OTHER MURRAY DEVICES

Aerial Ladder
Cable Racks
Malleable Strapping
Meter Boxes
Meter Seals
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Panelboxes
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HIGHEST
All-Year Efficiencies

HIGHEST
Short Circuit Protection

LOWEST
Temperature Rises

Murray

—the foremost name on current-limiting

REACTORS

Electrical World

FOUNDED IN 1874 • READ BY ELECTRICAL MEN FOR 69 YEARS

December 25, 1943 — Vol. 120, No. 26

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ished weekly. Price 25 cents a copy. ication office 99-129 N. Broadway, Albany, Y. Allow at least ten days for change of ress. Address communications about subtions to Director of Circulation, Electrical d, 330 West 42nd Street, New York 18, N.Y.

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cription rates: In the United States, ico, Central and South American coun- $5 a year, $8 for two years, $10 for e years, Canada $5.50 for one year, $9 two years, $11 for three years (Canadian y at par). Great Britain and British essions, 54 shillings for one year, 108 ings for three years. All other countries r one year, $18 for three years. Entered econd-class matter November 16, 1936, ost Office at Albany, N. Y., under the of March 3, 1879. Printed in U. S. A.

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GRAW-HILL PUBLISHING CO., INC.,
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330 West 42nd Street New York, 18, N. Y.
Director of Circulation:

Please change my address on Electrical World

From.....

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To.....

.....

Signed.....

Construction: Okolite insulation, copper shielding tape, weatherproofed braid. Bound to a Copperweld messenger with a crimped, spiraled 5-inch lay of copper tape. Full range of sizes and voltages.

No NEED FOR TREE TRIMMING WITH THIS NEW TYPE *Okolite Self-Supporting Cable*

TREE trimming ceases to be a costly, time-consuming process when Okolite Self-Supporting Cable is used — for *all* conductors are carried in *one* cable supported by a Copperweld messenger. In addition to the better appearance resulting from the elimination of major tree-trimming operations, Okonite's new aerial cable has greater mechanical strength to withstand high velocity winds, ice loads and the weight of fallen limbs.

Unlike other aerial cable designs which rely on rings for support, Okolite Self-Supporting Cable and its inbuilt messenger are a single unit that can be installed in one operation—*quickly* and *economically*. With this type construction, no movement between cable and messenger is possible. Ring cutting is eliminated and outages are materially reduced.

Our engineers will be glad to discuss the advantages of an Okolite Self-Supporting Cable installation. The Okonite Company, Passaic, New Jersey.

CHECK THESE ADVANTAGES OF OKOLITE SELF-SUPPORTING CABLE

- ☐ Better appearance
- ☐ Light in weight
- ☐ Long spans permitted
- ☐ No grade clamps required
- ☐ Reduces outages
- ☐ Prevents "bowing"
- ☐ Eliminates ring cutting
- ☐ Messenger can be used as a neutral

Bulletin OK-2033 describes a typical installation of Okolite Self-Supporting Cable, including costs and installation procedure. Write for your copy.

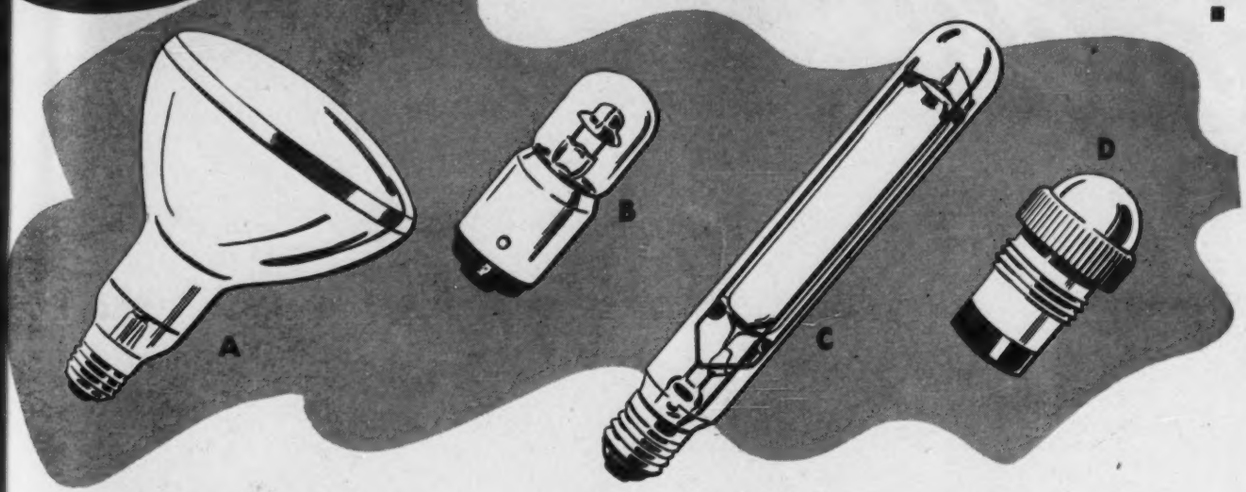
3410r

OKONITE

OKONITE

INSULATED WIRES AND CABLES

Quiz: CAN YOU TELL THE USES OF THESE SPECIAL LAMPS?



Need Lamps for Unusual Lighting Jobs? Here's How GRAYBAR can help you

• As a source of supply for lamps and lighting assistance, GRAYBAR is unusually well equipped to help you, whether your needs are standard or special, incandescent or fluorescent.

Because local GRAYBAR warehouses are "lamp headquarters" for so many industrial plants, utilities and lighting contractors, there's always more likelihood of finding the larger sizes and other less-widely used types in stock. Lamps for protective lighting, street lighting, and other outdoor uses are a GRAYBAR specialty.

For application requiring special lamps, GRAYBAR can keep you fully advised on the availability of G-E Mazda lamps of the types required. In addition, GRAYBAR lighting specialists are at your service in applying them.

Here are the ANSWERS (INVERT PAGE)

A — R-40 reflector drying lamp, used extensively for many different kinds of industrial drying operations.

B — T4 ½, ¼-watt G-E glow lamp, used as an indicator lamp in many war applications.

C — 400-watt T-16 type H Mercury lamp used for high levels of lighting in many industrial plants.

D — Bomb indicator lamp used on airplanes to signal "bombs away" and for other signaling purposes.

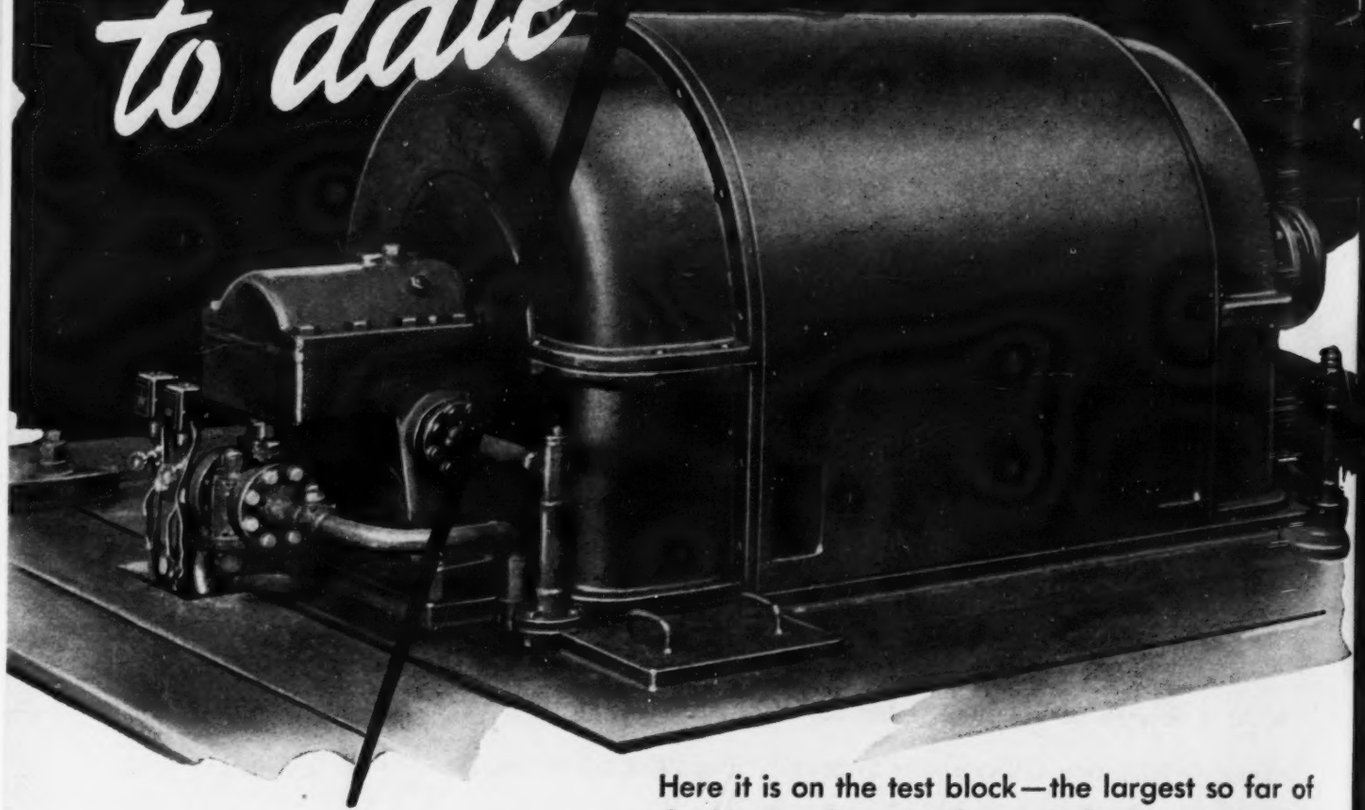
Everything Electrical ... THAT IT TAKES TO WIN!

Graybar

IN OVER 80 PRINCIPAL CITIES

Executive Offices: GRAYBAR BUILDING, NEW YORK 17, N. Y.

Largest to date



# of those big high-speed induction motors engineered by

Here it is on the test block—the largest so far of the big 2-pole squirrel-cage induction motors for high speed drive, for which the Elliott shops have become well and favorably known. This one is direct-connected to an Elliott centrifugal blower. The motor is rated 2500 hp. at 3580 r.p.m. It is enclosed, self-ventilated with air cooler, lubricated from an integral pressure-lubricated system, and the electrical characteristics are 3 phase, 60 cycles, 2300 volts.

Under test the motor easily exceeded its guarantees on every point—starting torque and Kva, temperature rise, efficiency, power factor. In operation it is unusually quiet and smooth.

If you have a drive job that calls for this kind of motor, let us talk it over.

ELLIOTT COMPANY
Electric Power Department, **RIDGWAY, PA.**
DISTRICT OFFICES IN PRINCIPAL CITIES

A star has been added to the Army-Navy "E" flags flown by both the Jeannette and the Ridgway plants of Elliott Company.

ELLIOTT

L-746

CHECK the FACTS

Type KOT

Type RKOT

1. Hi-Pressure spot contacts are wiped clean with each operation.
2. Uniform pressure form one-piece spring contact horn.
3. No gadgets. Few sturdy parts assures reliability.
4. Three-piece, high strength mounting brackets - clamps rigidly to crossarm with two half-inch bolts.
5. Clamps permits positioning to desired angle.
6. Extra heavy horn fibre lined bake-lite expulsion tube accommodates any universal link - also provides highest interrupting capacity, with long life. R&IE Thermo-Rupters recommended because of their positive action.

   Tubes interchangeable with repeating cutouts.
7. Uses any universal link. R&IE Thermo-Rupters recommended because of their positive action.

R&IE

OPEN TYPE CUTOUTS

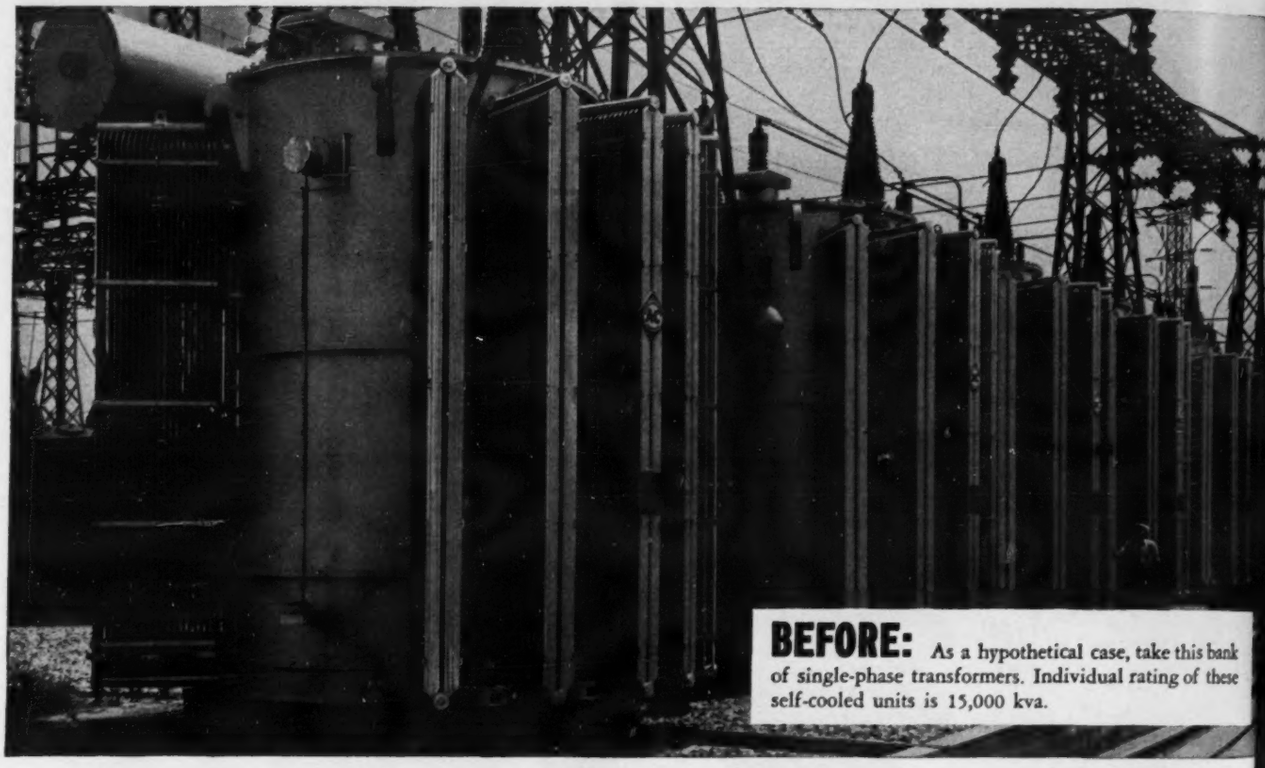
The Check List

- CONDUCTOR SUPPORTS CLAMPS AND FITTINGS
- DISCONNECTING SWITCHES INDOOR AND OUTDOOR
- AIR BREAK SWITCHES
- INTERRUPTER SWITCHES
- ✔ CUTOUTS AND THERMO-RUPTERS
- SWITCH OPERATING MECHANISMS
- SUBSTATIONS
- OPEN OR ENCLOSED, ISOLATED PHASE HEAVY DUTY BUSES
- KIRK INTERLOCK SYSTEMS
- AUTOMATIC SECTIONALIZING EQUIPMENT
- METAL CUBICLES
- TESTING DEVICES

AILWAY AND INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.

CANADA—EASTERN POWER DEVICES LIMITED TORONTO

STEP UP CAPACITY OF YOUR
WITH THE NEW ALLIS-CHALMERS
STURDY, PRACTICAL . . . A SOUND



BEFORE: As a hypothetical case, take this bank of single-phase transformers. Individual rating of these self-cooled units is 15,000 kva.

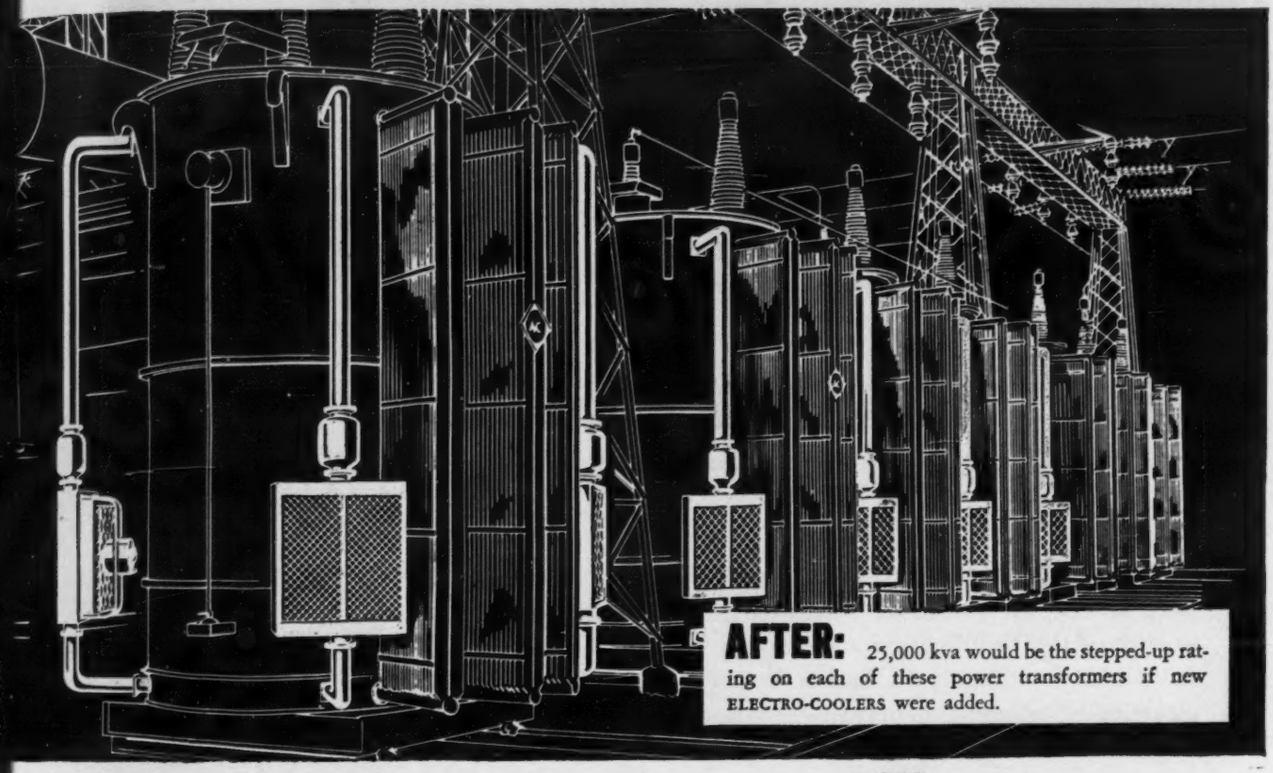
★ By accelerating flow of oil with pump action — and by forcing cooling air over radiator surfaces — ELECTRO-COOLERS jump transformer capacities!

★ New ELECTRO-COOLER is self-lubricating . . . employs no stuffing boxes . . . is outstandingly simple. Here's the coming thing in forced-oil cooling!

★ New transformers built with ELECTRO-COOLERS use 25% less copper and steel than formerly . . . cost correspondingly less!

ALLIS-CHALMERS

POWER TRANSFORMERS 20-60% ELECTRO-COOLER. IT'S SIMPLE, INVESTMENT FOR THE FUTURE!



AFTER: 25,000 kva would be the stepped-up rating on each of these power transformers if new ELECTRO-COOLERS were added.

HANDLING increased loads *without* adding new power transformers has become a serious wartime problem. To accommodate peak loads and relieve hard-pressed systems, Allis-Chalmers engineers designed the new ELECTRO-COOLER—a unit that *jumps* transformer capacities by as much as 60%!

Of compact construction with motor and pump on one shaft and in one frame... ELECTRO-COOLERS are self-lubricated... have *no* glands or stuffing boxes. Installation is simple, quick. *No* foundations are required!

For *all* facts about new ELECTRO-COOLERS contact our nearby district office. Or write for bulletin B-6242. ALLIS-CHALMERS, MILWAUKEE, WIS. A 1641

Factory assembled ELECTRO-COOLER shipped as a complete unit — saving time.

No glands or stuffing boxes! Oil drips, air bubbles eliminated. No packing to fix.

Only one shaft! Motor and pump are designed as a complete unit—in one frame.

Simplicity! 3-phase squirrel cage motor has no starting brushes, commutator or other such wearing parts.

High-pressure test reduces possibility of oil leaks.

TRANSFORMERS

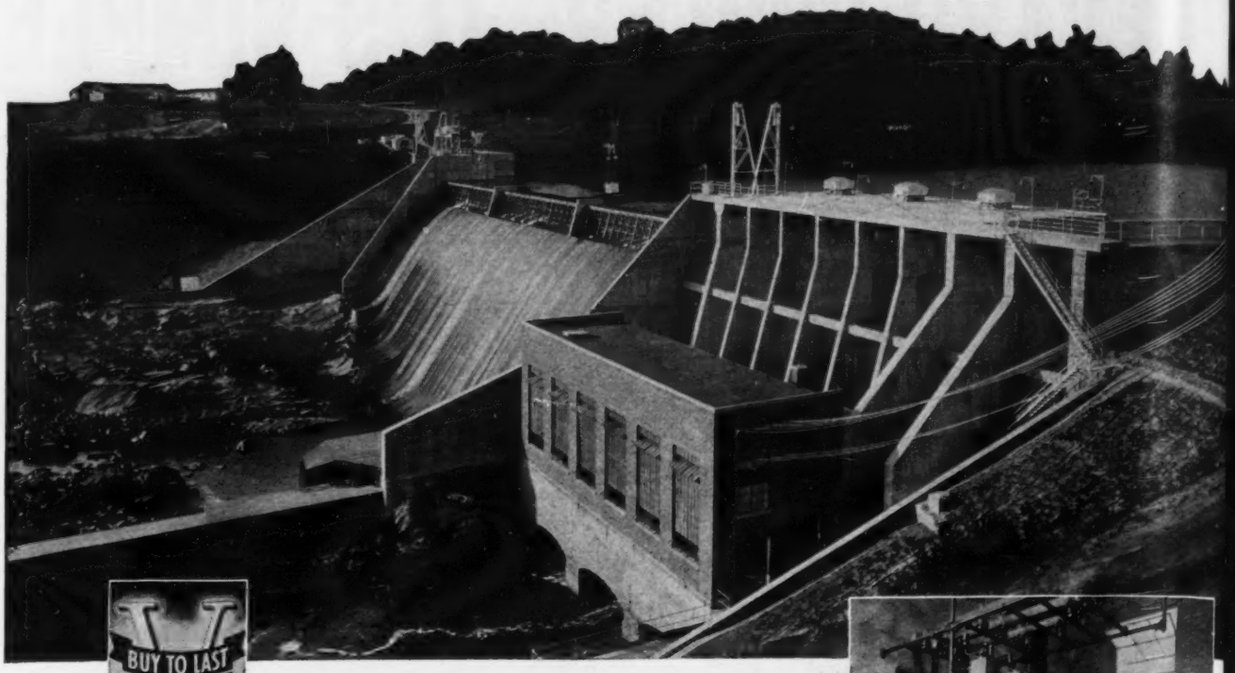
ALLIS-CHALMERS A-C MILWAUKEE

WE WORK FOR VICTORY

WE PLAN FOR PEACE

This Modern Station Chose

EXIDE-CHLORIDE BATTERIES



BUY TO LAST
SAVE TO WIN

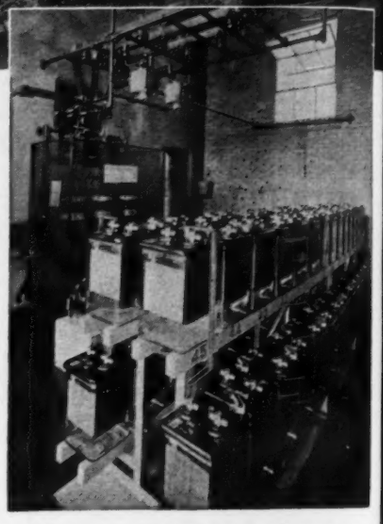
The Ayers Island Station of the Public Service Company of New Hampshire.

This fine modern station, known as the Ayers Island Station, is one of a number included in the comprehensive system of the Public Service Company of New Hampshire. It would be difficult to find a better equipped or more electrically efficient generating station than this 10,500 k.v.a. hydro-electric station located at Bristol, N. H.

When this modern station was constructed, every item of equipment . . . from generators to push buttons, was selected only after conclusive proof that it met in every way the high standard set by the Public Service Company.

It is not surprising, therefore, that a 60-cell Exide-Chloride Battery was installed to operate the oil circuit breakers and to furnish emergency lighting within the station.

For control bus, emergency light, and other stationary services, Exide-Chloride Batteries have earned the confidence of engineers everywhere. Proof of this continued confidence is seen in the great number of public utility and private industrial plants that rely on Exides. When you buy an Exide, you buy dependability, long life, and ease of maintenance over a long period of years . . . which means you *Buy to Last.* Take care of your Exide, and *Save to Win.*



Sealed jar assembly of the 60-cell Exide-Chloride battery permits installation adjacent to other electrical equipment with absolute safety.

ARMY E NAVY

Exide
CHLORIDE
BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia 32 • Exide Batteries of Canada, Limited, Toron

YOU CAN'T MAKE ANY

Wild Shots

ON INSULATOR STRENGTH

PUT enough shots in or near the bullseye, and your score will be high in spite of an occasional wild one. But you can't do this when dealing with suspension insulator strength. No matter how many insulators it takes to hold up a line, it takes only one to drop it. You can't make any wild shots on strength...How is this avoided? First, by O-B's outstanding developments in precise manufacturing control that make possible a highly uniform product. Second, because of this uniformity, mechanical ratings of insulators on the basis of minimum strength--*not average!*..Average strength insulators don't make trouble. It's only the weakest unit that needs attention. O-B minimum strength ratings establish values which every unit will equal. They are specific. They are reliable. They bring you the kind of strength that *counts*, because you can *count* on it!

Ohio Brass

MANSFIELD, OHIO

CANADIAN OHIO BRASS COMPANY, LIMITED,
NIAGARA FALLS, ONTARIO

2406-H

★ ★ ★ KEEP BUYING WAR BONDS ★ ★ ★

Fourth of a series of statements about ETL *comprehensive services*

COMPREHENSIVE SERVICES IN PROMOTION OF GOOD QUALITY IN LAMPS AND LIGHTING

As a part of its services to producing and purchasing clients ETL has a Research Department that is called upon to investigate obscure aspects of performance, including the influence of external variants, and to devise and design fault detectors, inspectional aids and test devices. The services of this Research Department are available to all clients but are regularly engaged in connection with annual contract work for

CERTAIN ELECTRIC UTILITY COMPANIES
THE MAZDA LAMP MANUFACTURERS

The independent research of ETL supplements research provisions made respectively by producers and purchasers. It is the fourth of the elements of ETL's *comprehensive services* in connection with lamps and lighting. The ideas and material that enter into ETL research are of greater significance than they would otherwise be because they grow out of ETL operations in producers' plants, in tests at ETL headquarters and in service investigations.

ETL services are available to any manufacturer and to purchasers of his product who care to avail of them.

ELECTRICAL TESTING LABORATORIES, INC.
2 EAST END AVENUE AT 79th STREET, NEW YORK 21, N.Y.

Will O-B Bushings Last 1000 Years?

* *Cleveland Museum of Art*

Here is a delicate porcelain dish nearly a thousand years old. The layman might pass it by as "new merchandise". Aside from breakage, its fragile nature exposes it to all the forces of deterioration that ten centuries might bring. Yet it's still new! . . . What does this tell us about modern electrical porcelain? We know that, today, porcelain possesses excellent dielectric qualities; it is totally weatherproof, and small accidental electrical discharges across its surface cannot leave a permanent conductive scar that will eventually lead to break-down. These and many other reasons account for O-B's use of porcelain for **internal dielectric** in all bushings . . . But, this ancient dish tells us more about porcelain -- something that we haven't lived long enough to know ourselves. Porcelain is changeless. Its original qualities endure indefinitely. This dish adds an important chapter to the story of O-B porcelain-insulated bushings. It adds a vital time factor to the basic facts of porcelain's good insulating qualities.

Only in O-B bushings can internal porcelain dielectric be obtained. Specify these bushings for lasting performance.

Ohio Brass

MANSFIELD, OHIO

CANADIAN OHIO BRASS COMPANY, LTD.,
NIAGARA FALLS, ONTARIO

2414-H

Here's A Fine Opportunity For Someone.....

This publication needs a

PROMOTION *and* RESEARCH MAN

We're looking for an electrical man with a yen to get into advertising and publishing...or an advertising man who knows his way around in the electrical business.

We've heard all about the manpower shortage, but somehow we've got a feeling that there's a man around who would welcome this opportunity to get established with one of the world's largest publishing houses . . . McGraw-Hill. This particular job is vacant only because the man who held it has been moved up the ladder. In other words, it's no war baby.

Here's the sort of a man we're looking for. We don't expect to find all these qualifications rolled up into one individual, but the more you have the better.

He likes to write. It's not painful for him to sit at a desk and pour out words. He expresses himself clearly on paper and enjoys doing it. Maybe he has written some advertising, edited a house organ, or handled publicity for a manufacturer—at least enough to get the taste of printer's ink and like the flavor.

He has a liking for research . . . . if he hasn't done much of it, at least he is curious enough to want to investigate things, and he has the patience and sound grasp of elementary mathematics that will enable him to supervise tabulations, work out the results in chart form, etc.

He has some technical background. If he's a full blown E.E., M.E., or something that would be fine . . . but all we really insist upon is that he has an understanding of things electrical . . . can go into a utility or an electrical contractor's shop and have a reasonable grasp of what goes on.

In replying tell us such facts as your age, draft status, salary desired and anything else that you think will help us fit you into the picture. The job is open right now, so the sooner the better.

ELECTRICAL WORLD

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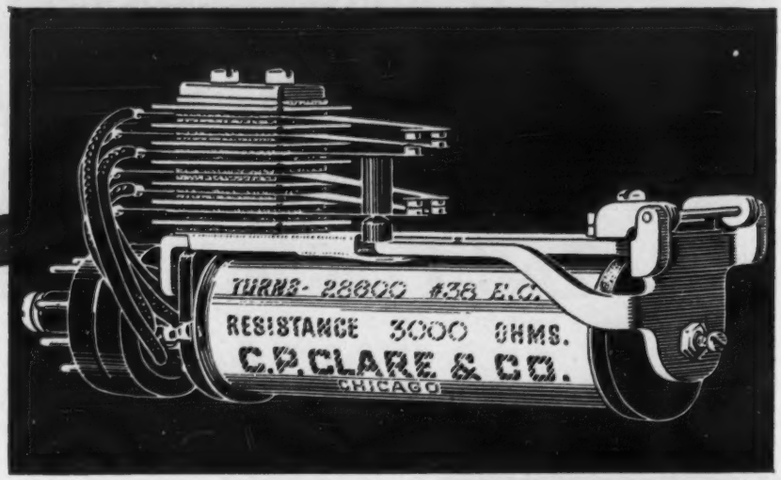
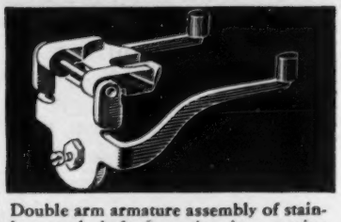
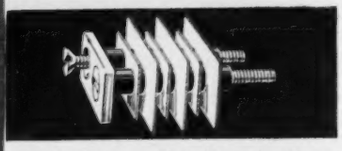


Unusual Contact Arrangements?

CLARE "Custom-Built" RELAYS Exactly Fit Utility Needs

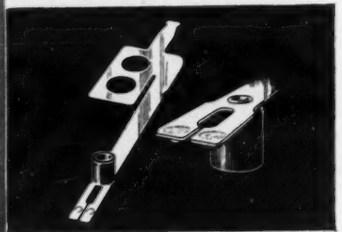


Double arm armature assembly of stainless steel shaft, operating in a marine brass yoke. Heel piece, core and armature assembly are of magnetic metal.



High voltage spring pile-up insulators of special heat treated Bakelite. Has minimum cold flow properties, low moisture absorption content and permits punching without cracks or checks.

Contacts are welded to nickel silver springs by special process. May be of precious metals or alloys in 12 different standard or special types and sizes.



Spring bushing insulators are made of Bakelite rod under patented process. Resist vibration and withstand heavy duty service.

Innumerable contact arrangements are possible with Clare Type C d.c. Relays because Clare "Custom-Built" means that the relay you buy is supplied with just the contact arrangements for the specific job.

This Clare Type C Relay meets the demands of a dependable relay for such important installations as:

- ★ **Automatic sub-stations** . . . to initiate and control equipment.
- ★ **Power stations**...especially steam plants—for control of fuel feed, water, and steam pressure and steam out-put.
- ★ **Pressure recording systems**...for indicator and alarm circuits.
- ★ **Sequence control** and **interlocking operations.**

Here are some of the construction features in-built into Clare Type C Relays which have earned their high reputation as dependable and versatile relays for utility use:

Standard spring assemblies may embody any combination of five contact arrangements. As many as 20 springs per pile-up with two pile-ups per relay are available.

Coils are carefully wound to exact turns on precision machines. Lead-out wires are securely soldered.

Coils are protected with a transparent acetate covering . . . are available impregnated with special varnish.

Octal base plug mounting is illustrated. This makes for easy service and replacement. Other types of mounting, such as individual angle bracket, strip or panel, can be furnished.

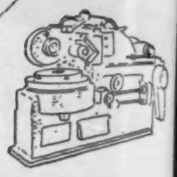
All Clare Relays are carefully designed, well manufactured from best materials and precisely adjusted. These features assure that the Clare Type C d.c. Relay will reduce overall relay cost, simplify installation and insure better and more dependable performance.

Clare engineers are ready at all times to assist you in developing a relay specifically "custom-built" to meet your requirements. Send for the Clare catalog and data book. C. P. Clare & Co., 4719 Sunnyside Avenue, Chicago (30), Illinois.

CLARE RELAYS

"Custom-Built" Multiple Contact Relays for Electrical, Electronic and Industrial Use

The Right Contacts Are Insurance Against Lost Production Time—



With production lines feverishly at work, a motor switch failure may cause a plant-wide crisis because it bottlenecks an essential machining or assembly operation.

Controls must carry their load under all conditions; motor starting switches must operate without breakdown. The right contacts are the best insurance for dependable, unfailing performance.

In designing a motor starting switch to handle the current required for a 4-horsepower, 3-phase motor, a motor control maker specified ordinary contact material. On test, the switch proved unreliable; could not handle the current requirements. Contacts welded together, became inoperative.

Mallory contact engineers were appealed to; sized up the difficulty; recommended a new Mallory alloy, Elkonite* D-54. Presto! Troubles were overcome and Elkonite D-54 now insures reliable operation even under overloads. Just another case of quick diagnosis and remedy arising from Mallory experience and "know-how."

Leading manufacturers of motor controls and circuit breakers have long looked to Mallory for complete contact assemblies and contactor facings to insure accurate, unvarying protection to essential circuits in their customers' plants.

The reputation of Mallory engineers as contact "trouble shooters" has become proverbial; nowadays it is common practice to call in Mallory for complete contact assembly recommendations before the design is off the drawing board. It saves time and money in designing, it prevents lost time when the device is in operation.

While the design is still in blueprint form

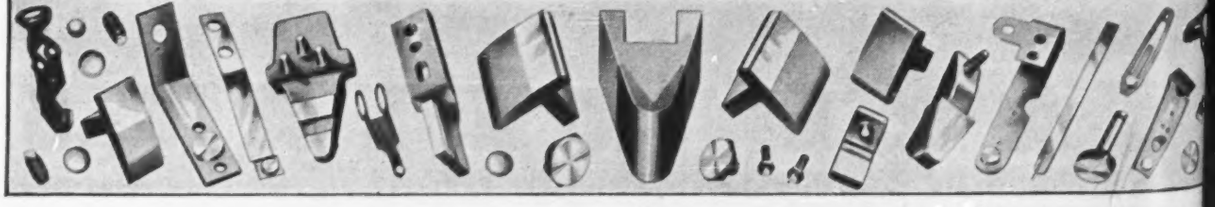
CONSULT MALLORY
for Contacts and Contact Assemblies

P. R. MALLORY & CO., Inc., INDIANAPOLIS, INDIANA
Cable Address—PELMALLO

P. R. MALLORY & CO. Inc.
MALLORY

*Reg. U. S.

ELECTRICAL CONTACTS AND CONTACT ASSEMBLIES
NON FERROUS ALLOYS, POWDERED METAL ALLOYS



THER ESSENTIAL INDUSTRY SERVED BEST BY FWD TRUCKS

In Utility Line Construction and Maintenance FWD trucks do the Difficult Jobs in all weather on and off the Highway

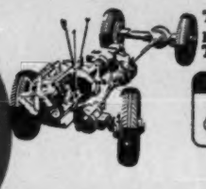
Keeping power and communication lines in service is an essential industry at all times. Motor trucks must be equal to everything that an emergency calls for — get through with trouble-shooting crews — in all weather and to locations on or off the highways.

FWD trucks are first choice of more than 150 Public Utilities — coast to coast, Southern California to Canada and Alaska. Fleets of more than 200 FWD's are in year-round service with many companies.

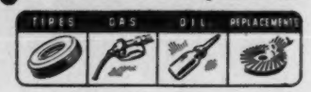
Here is another instance of FWD's leadership in a basically important field of motor truck service. Wherever there is important work to be done, FWD trucks are always in evidence.

THE FOUR WHEEL DRIVE AUTO CO., Clintonville, Wis.
***Canadian Factory:* KITCHENER, ONT.**

FWD TRUCKS



The True Four-Wheel-Drive Principle With Center Differential Saves: Tires • Gas • Oil • Replacements

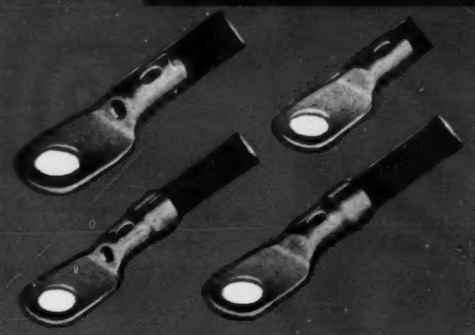


THE OLDEST AND ORIGINAL EXCLUSIVE . . . *BUILDERS OF FOUR-WHEEL-DRIVE TRUCKS*

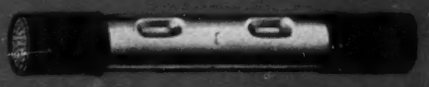
IN EVERY FIELD WHERE TRUCK QUALITY IS PUT TO THE TEST · · · FWD's STAND UP

compactness

makes Burndy HYDENT Connectors space savers..time savers, too!



HYLUG . . . one-piece terminals, for all wire sizes from No. 29 up, with either open or closed backs, with or without split or solid insulation shrouds.



HYLINK . . . one-piece end to end connectors for all wire sizes from No. 29 up, with or without insulation shrouds.

LINKIT . . . the famous Burndy separable connector which has no loose or extra parts. For wire sizes from No. 22 up.

Patent No. 2,109,837

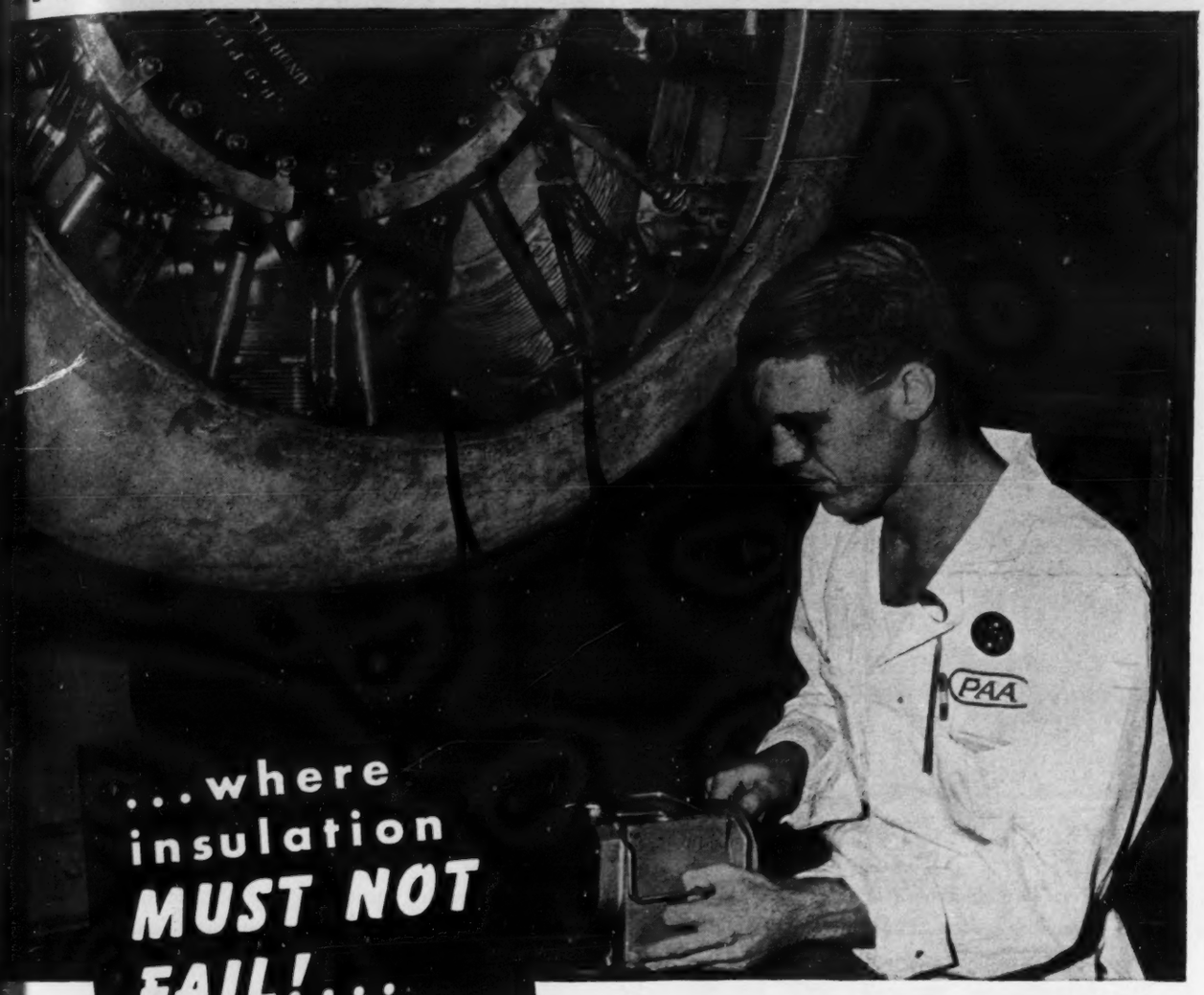
For crowded locations, HYLUGS are real *space savers* due to their shorter barrel, and more compact overall design. They're *time savers*, too, because this virtue simplifies and speeds up assemblies. Despite their extreme compactness, however, HYLUGS are *stronger mechanically*, and *more efficient* electrically . . . because they are formed from pure copper, in *one piece*. Burndy's exclusive *forming* process imparts *high strength*, and one-piece construction eliminates the hazards of extra contact surfaces. HYLUGS and other HYDENT connectors are fully described in the new HYDENT catalog. Write for your copy now.

BURNDY ENGINEERING COMPANY, INC.

BURNDY electrical connectors

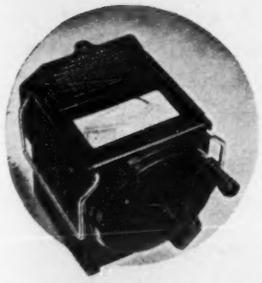
107 EASTERN BOULEVARD, NEW YORK 54, N. Y.

AT PAN AMERICAN AIRWAYS...



...where insulation MUST NOT FAIL!...

...they use "MEGGER"* TESTING INSTRUMENTS



The New U. S.-made "Megger" Insulation Tester

Now in full production and equal in every respect to former models. Hand-cranked generator and direct-reading ohmmeter mounted in plastic molded case. Ratings up to 1000 megohms and 500 volts d.c. Variable and constant-pressure types. *Bulletin 1735-W.*

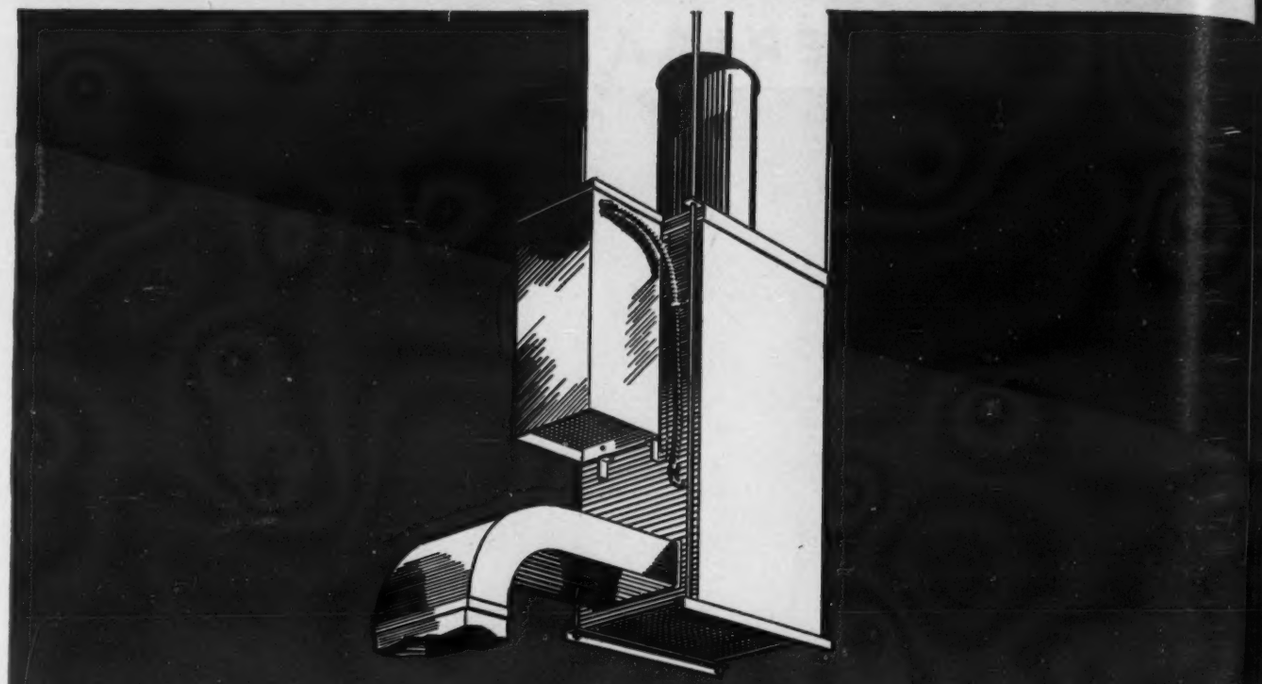
Conditions of extreme heat, cold, moisture, vibration and corona are but some of the hazards to electrical insulation that are inherent in aircraft services. By carefully checking ignition harness, circuits and electrical equipment at frequent intervals with "Megger" Insulation Testers, aircraft maintenance men insure against electrical failures in flight.

Years ago, Pan American World Airways selected "Megger" instruments for this vital work and now, at Pan American bases throughout the world, the "Megger" tester is literally "first and last" in the ground crew's maintenance procedure.

Likewise, industry is today guarding its electrical equipment more than ever before and "Megger" Insulation Testers provide the means for this protection. Write today for a copy of our *Pocket Manual of "Megger" Practice No. 1420-W*—which presents the why and how of "Megger" testing.

** Trade Mark Reg. U. S. Pat. Off.*

JAMES G. BIDDLE CO. · 1211-13 ARCH STREET · PHILADELPHIA 7, PENNA.



Because they hang it on the Ceiling

Here's an electrostatic air cleaner that is hung from the ceiling. The very act of hoisting it up there, regardless of all the other advantages gained, just naturally calls for the light weight of aluminum. (Speaking postwar, of course, though it's none too early to be doing this kind of Imagineering.)

And, if it were made of lightweight Alcoa Aluminum, think how much lower a load you'd be placing on the building. Perhaps much wider markets could then be uncovered for this device in places where weight is still more of a deciding factor.

Add the fine appearance of aluminum and its ability to resist corrosive atmospheres, the high electrical and thermal conductivities of aluminum, and its nonmagnetic property. What a list of reasons for considering aluminum for many electrical devices!

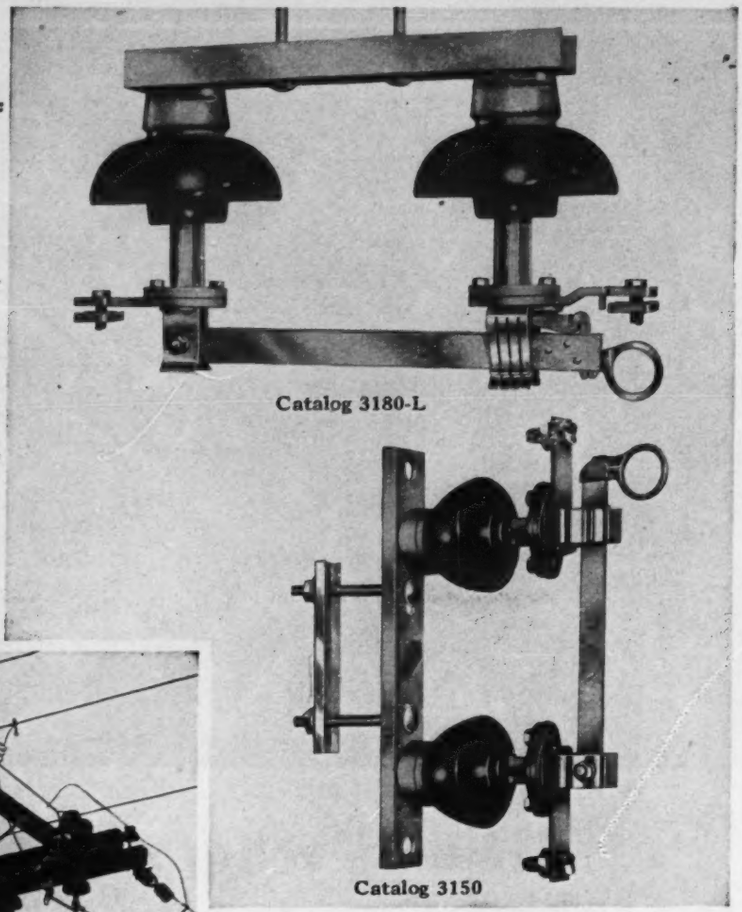
Put your products in place of this one, and figure what Alcoa Aluminum will do for them. Alcoa engineers will gladly help you weigh these reasons against what you wish to accomplish. Write ALUMINUM COMPANY OF AMERICA, 2138 Gulf Building, Pittsburgh, Pennsylvania.

IMAGINEERING AT WORK

ALCOA A·C·S·R

OPEN TYPE
MATTHEWS DISCONNECTING SWITCHES

Adaptable for Horizontal or Vertical Mounting



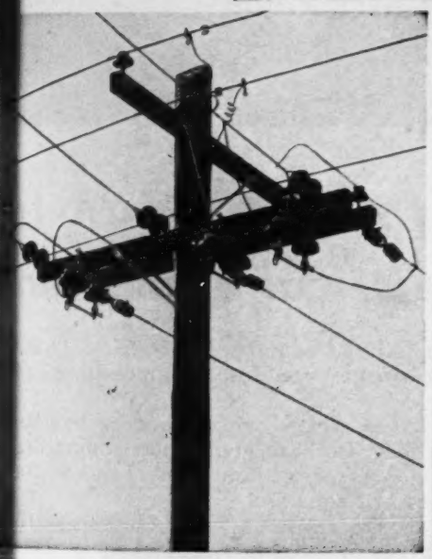
Catalog 3180-L

Catalog 3150

High Quality Materials Mean Lowest Time-Cost

•

No Radio Interference at Rated Voltage



Shows installation of Catalog 3158 Matthews Disconnecting Switches.

Where cost of equipment is limited due to low revenue lines, these low-cost, substantially constructed, hot stick operated Matthews Disconnecting Switches will meet your needs for economical and efficient operation.

Special insulators of our own design, have ample electrical values for their respective ratings in accordance with NEMA Distribution CUTOUT Standards, Publication 38-53. Galvanized certified malleable iron caps and pins are securely cemented onto insulators in accordance with our 96-hour natural cement curing process which has given perfect satisfaction in the field for over twenty years.

All current carrying parts are of at least 85% copper content material; all other metal parts are hot galvanized.

The 200-ampere Disconnecting Switches are equipped with single, heavy bus bar copper blades, while the switches rated 400 amperes have double blades. All can be furnished with blade latches, as illustrated, at additional cost.

Female contact clips of bus bar copper, reinforced by spring phosphor bronze retainer clips, assure positive contact with no overheating, at full rated load.

Matthews Disconnecting Switches are made in 200 and 400 Ampere sizes and 7.5, 15 and 23 Kv. Ratings.

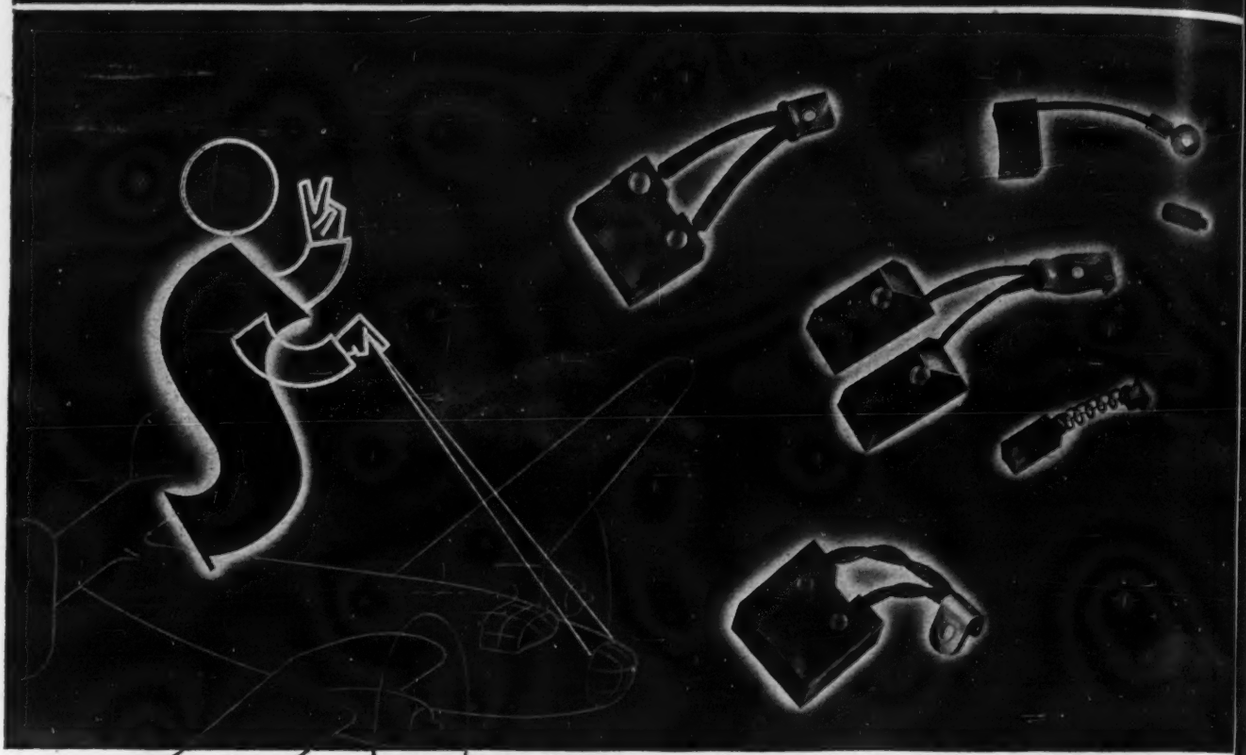
Write for Bulletin 106
It gives complete information.

W. N. MATTHEWS CORPORATION

SAINT LOUIS, U. S. A.

ENGINEERS and MANUFACTURERS SINCE 1899

THE FIRST OUTSTANDING BRUSHES FOR HIGH-ALTITUDE SERVICES



. . . and what they mean to earth-bound electrical equipment

HEADQUARTERS FOR MOLDED CARBONS, GRAPHITES, METALS and COMPOSITIONS

Brushes and Contacts
(*All carbon, graphite, metal, and composition types*)
Rare Metal Contacts
Bearings
Welding Rods, Electrodes, and Plates
Brazing Blocks
Rheostat Plates and Discs
Packing, Piston, and Seal Rings
Carbon Regulator Discs
Sintered Iron Components
Carbon Pipe, etc.

Not long ago, aviation services at 30,000 feet and up were seriously handicapped by the fact that generator brushes would not last more than a few dozen hours.

Today, however, Stackpole brushes, treated with a process developed by the Westinghouse Electric & Mfg. Co., are giving outstanding high-altitude performance at dozens *of hundreds* of hours! As of this writing, their performance record has yet to be equalled!

This development is typical of the constant Stackpole engineering improvement in brushes for all types of rotating electrical equipment. It proves once again that brush problems don't stay answered. Brushes which may have been satisfactory yesterday are rendered obsolete by today's developments. That's why it pays to check brush requirements *regularly* with the latest that Stackpole engineering may have to offer.

STACKPOLE CARBON CO., ST. MARYS, PA.

STACKPOLE

BETTER BRUSHES FOR TODAY'S JOBS

Flexible Cables

FOR PORTABLE AND MOBILE Electrical EQUIPMENT

Rubber sheathed flexible cords and cables for portable or mobile electrical equipment were made first by Simplex and introduced about twenty-five years ago. They quickly proved their superiority for such service over older types of cables and were soon in general use.

Simplex-TIREX - rubber sheathed - cords and cables have been the acknowledged leaders in this field ever since. Improvements made from time to time have maintained their leadership and millions of feet of tough, abrasion resistant Simplex-TIREX are in service today.

Recent government regulations prohibit the use of natural rubber in insulation or sheath. Synthetic compounds have been developed to carry on for the duration and already have proved their ability to render satisfactory service. They will fill in now for the Simplex-TIREX that, during the past quarter century, has built up such enviable performance records in mines, mills and wherever electrical equipment depends upon flexible conductors for power.

SIMPLEX *War* TIREX——

cords and cables with synthetic insulation and sheath are available for essential projects. If you need cords or cables for machines or tools engaged in war work, you should learn what Simplex "War" Tirex cords and cables can do for you.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.

ARMY (E) NAVY

M

Simplex

WIRES and CABLES

The women

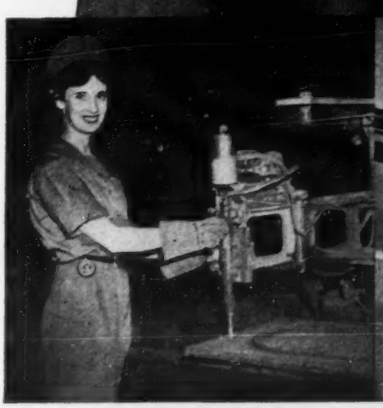
They know that this is war, and that the price of victo will be high. They have sent off their sons, brothers a husbands to the armed forces, and they are coming o of beauty shops and offices, stores and homes, and a taking war jobs in steel mills and shipyards. The d hands that in peacetime wielded the skillet and t dryer are now managing the boring mill and the we ing torch—and to very good effect.

Ever try keeping traffic flowing smoothly in and o of the main entrance of a big steel plant? Ever knock "hot top" off an ingot? Or rough-bore a gun forgi Or weld a ship's hull? Not women's work? Women a every day doing these and dozens of other jobs in Be lehem shipyards and steel plants, and doing th superbly.

At Bethlehem and Lackawanna, at Baltimore, at Fo River and Hingham, on the Pacific Coast—and at oth locations where this company operates plants and shi yards—former clerks and beauty-shop operators, sal girls and housewives, are applying themselves to th new, challenging tasks with wonderful spirit and sk They are helping to swell the mighty output of steel a ships and ordnance. The results of their efforts are be painfully felt in Tokyo and Berlin. Hats off to them!

★ ★ ★ BETHLEHEM STEEL ★ ★

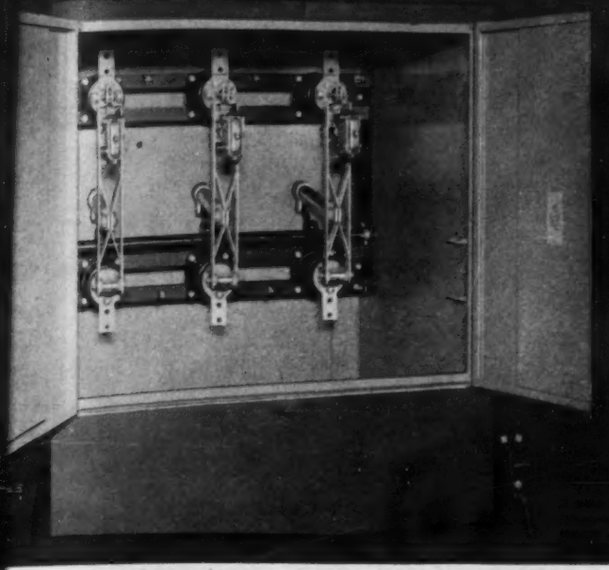
Woman "patrolman" at a Bethlehem steel plant. Here is a job call for plenty of tact and skill! Women are serving on patrol duty at gat parking lots, offices, and other locations with efficiency and aplo



Once a dancer, now she runs a machine in a Bethlehem shipyard.

This "buggy" operator is hauling naval shells in a Bethlehem plant.

Upswept hairdo, red finger-nails, don't keep this welder from doing a man-size job at a Bethlehem shipy



BREAKS LOAD WITHOUT ARCING

At the Main Switch Contacts

THE S&C

Load Interrupter

UNIT DOES IT!

● The S & C Circuit-Interrupting Unit clears both exciting and load currents up to 400 amperes with no arcing at the disconnecting switch contacts. The breaking of the main switch contacts transfers the current to the Load Interrupter Unit, where the circuit is broken without external arcing in one cycle or less.

Use S & C Load Interrupting Switches—

- **For sectionalizing feeder circuits.**
- **To disconnect capacitor banks.**
- **To isolate transformer banks.**
- **To disconnect lighting loads.**
- **To interrupt exciting current of feeder regulators.**

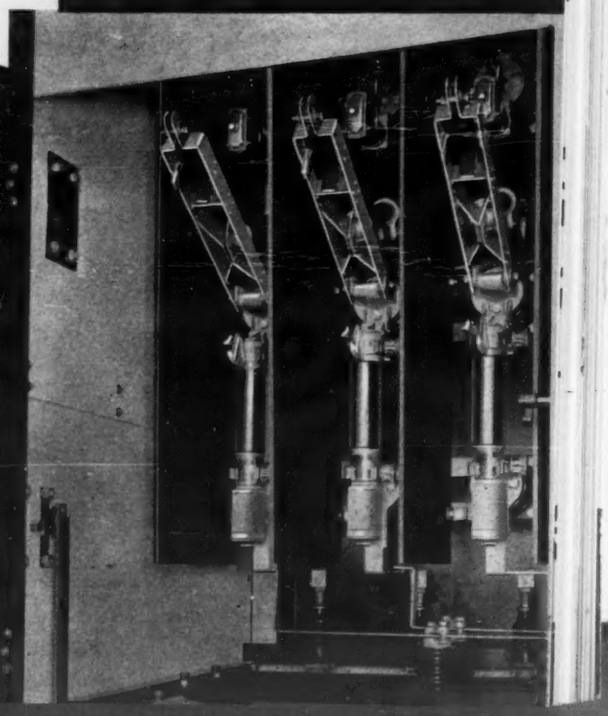
In Combination with S & C Power Fuses—

- **For substation feeder circuits.**
- **For branch distributing feeders.**
- **For high voltage switching and short circuit protection on primaries of industrial customer substations.**

The Load-Interrupter Switch is capable of interrupting up to 400 amperes at 15,000 volts without drawing an arc across the main switch contacts. The Heavy Duty Fuses have short-circuit interrupting ratings of:—20,000 r.m.s. amperes at 13,200 volts; 25,000 r.m.s. amperes at 6600 volts; 30,000 r.m.s. amperes at 2300/4000 volts.

The wide acceptance and use of S & C Load Switching and Fuse Combinations during the past few years has been the means of saving much critical metal, while reducing initial and maintenance costs. Write today for Bulletins 202A and 763.

3-Pole Cabinet-enclosed Load Interrupter Switch and Fuse Combination. Switch rating, 7500V, 400A; Fuse rating, 200A max., 17,500 rms amps. short-circuit interrupting rating.

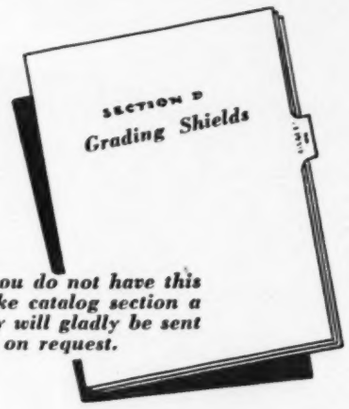


Hundreds of cases have been reported where, despite severe arc burns on the shields, insulators and conductors have not been touched.

Protect ...with Locke Grading

... Line flashovers are bad medicine for conductors and insulators ... particularly today when replacements are not readily available.

Locke Grading Shields definitely minimize the possibility of flashover . . .



If you do not have this Locke catalog section a copy will gladly be sent you on request.

1 Due to improved voltage distribution and energy dissipation from the shields many flashovers are actually prevented.

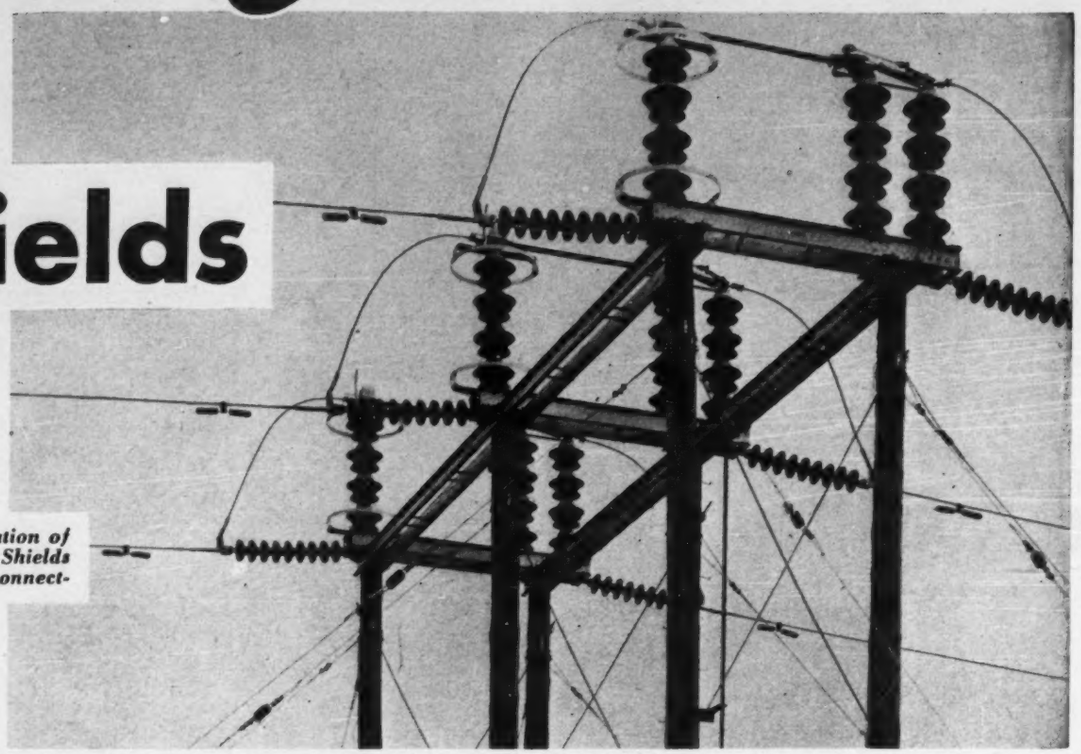
2 By inducing more uniform voltage distribution over the insulator string they stop "creeping" breakdown which may result from over voltage on the line unit.

3 Flashovers which do occur are controlled. Cascading is extremely rare when Locke Grading Shields are used. The arc forms between the shields and is kept away from both insulators and conductor.

LOCKE INSULATOR

Protect Your Conductors

with Locke Grading Shields



A typical installation of Locke Grading Shields on a 161kv disconnecting switch.

. . . for switches and lightning arrestors, too . . .

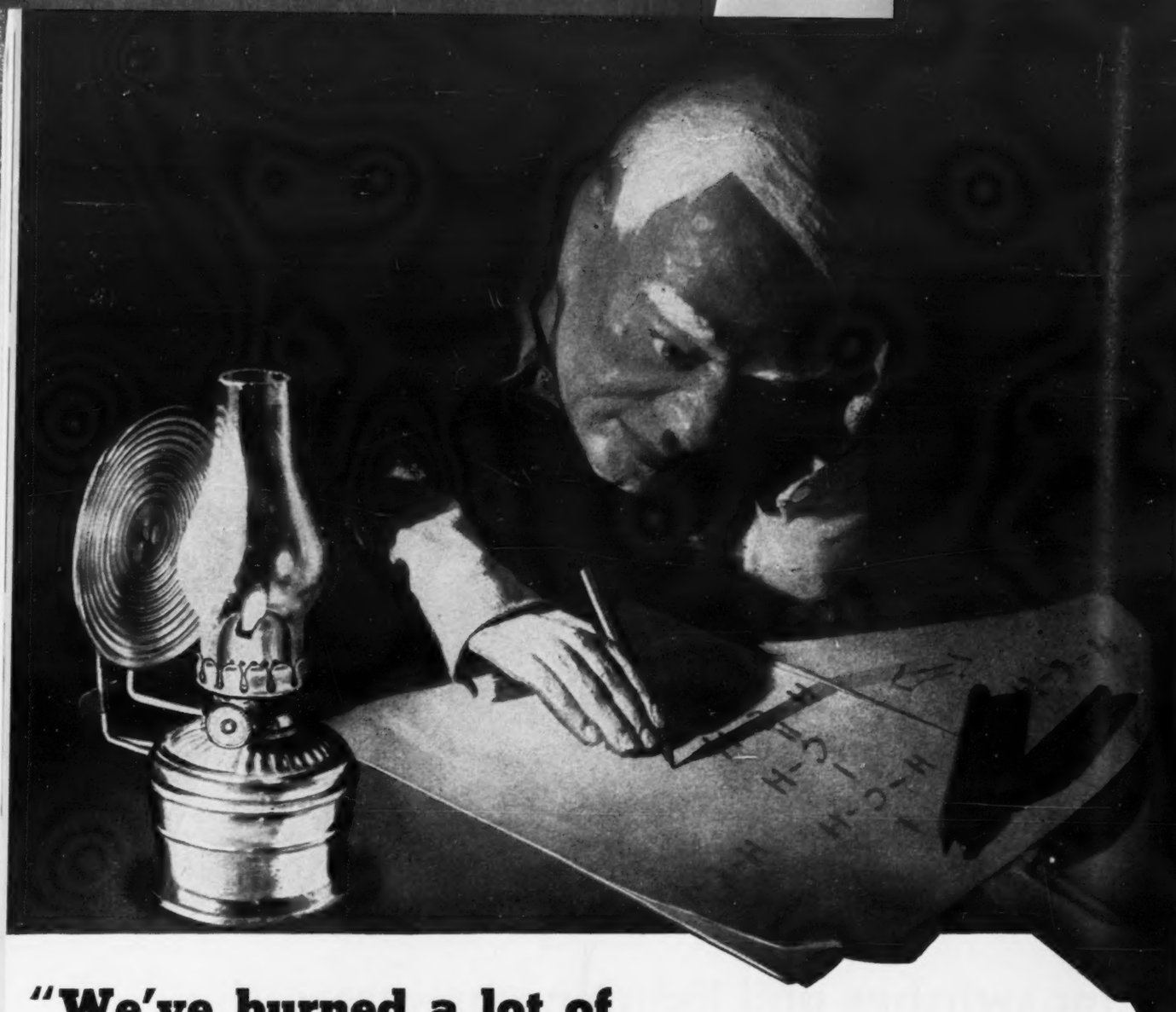
Locke Grading Shields, by improving the voltage gradient over the stack, prevent corona formation.

They reduce the possibility of cascading under flashover with its attendant damage and expensive interruptions to service.

Set to gap the stack they safely limit the flashover values without reducing leakage distance.

FIFTY PROGRESSIVE YEARS OF SERVICE TO THE ELECTRICAL INDUSTRY

LOCKE INSULATOR CORPORATION BALTIMORE MARYLAND



"We've burned a lot of midnight oil"– says *Romey

"During the rubber famine we have burned a lot of midnight oil developing insulating compounds from the available substitutes.

"As a result we are able to offer insulated wires and cables that are safe and satisfactory.

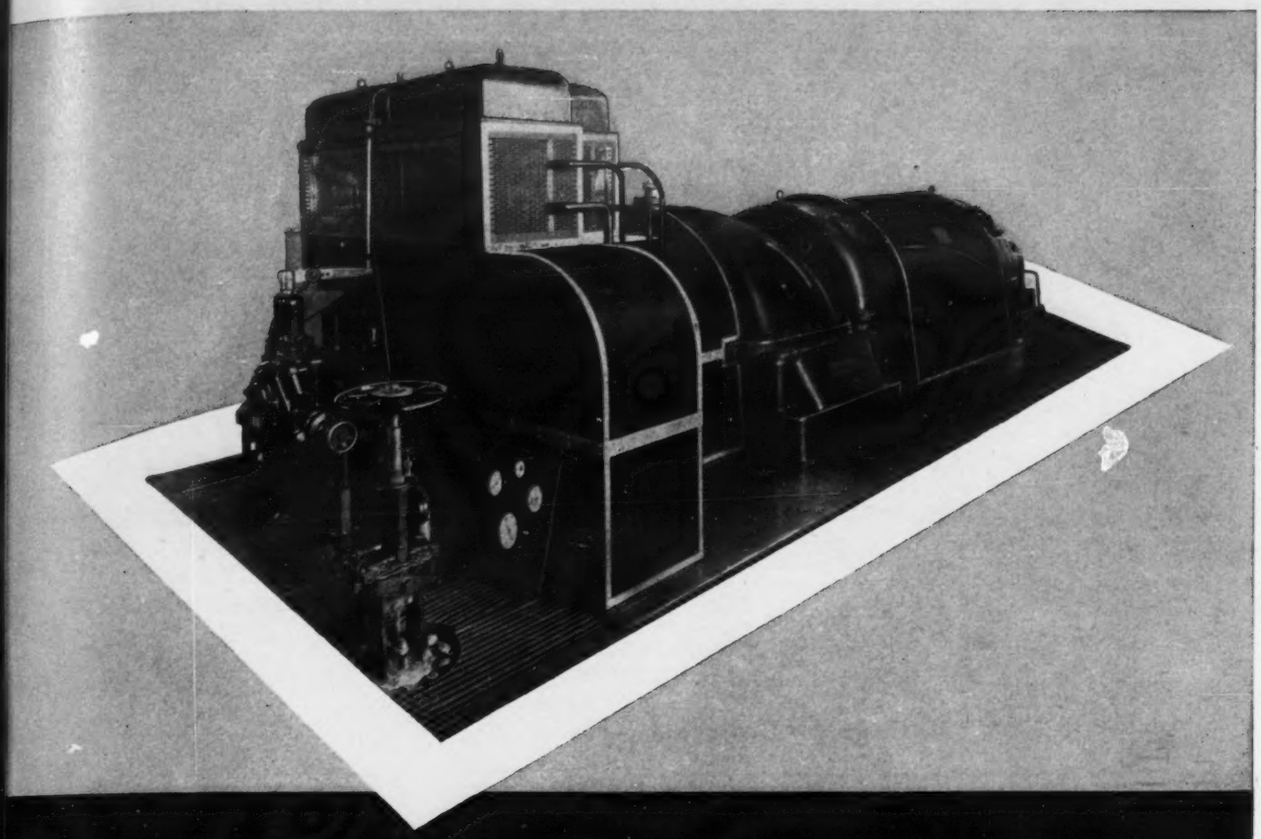
"Even though they do not always meet the test values that were possible when natural rubber was available, they satisfy every practical need and are mighty good for war-time products.

"Give us a little more time and experience and they will be equally as good as rubber."

FROM BAR TO FINISHED WIRE

ROME CABLE CORPORATION

ROME • NEW YORK



Alchlor Process refining makes Gulfcrest Oil a better lubricant for your Turbines

You are sure of better turbine lubrication when you put Gulfcrest Oil in service. For this highest quality lubricating oil is not only refined by conventional methods, but is super-refined by the Gulf Alchlor Process, the most effective method for producing a turbine oil that has maximum resistance to oxidation and sludge. Gulfcrest Oil is the world's finest turbine lubricant!

It will pay you to talk with the Gulf Lubrication Service Engineer in your vicinity about this superior turbine lubricating oil at your first opportunity. He will be pleased to give you the facts—without obligation.

4 Reasons why Gulfcrest Oil is the Turbine Lubricant of Unparalleled Quality

1 REFINED BY THE ALCHLOR PROCESS. The most thorough and effective method for removing chemically active or unstable hydrocarbons as well as other impurities present in all crudes.

2 HIGHEST RESISTANCE TO OXIDATION. Because this famous ALCHLOR Process synthesizes and rearranges the molecular structure of certain hydrocarbons more susceptible to chemical change in service, the finished oil has greater stability. GULFCREST OIL stands alone in its high resistance to oxidation.

3 HIGHEST RESISTANCE TO THE FORMATION OF ORGANIC ACIDS AND SLUDGE. Because of the elimination or rearrangement of the less stable hydrocarbons the unparalleled refining power of Alchlor Process provides oils that form less gum and deposits, less sludge, and a higher resistance to emulsification when mixed with water, insuring years of continuous service.

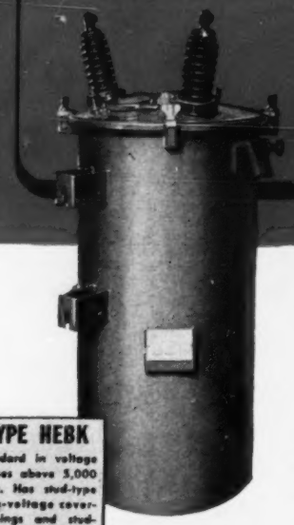
4 MAXIMUM K.W. OUTPUT PER UNIT OF CONSUMPTION. Because the Alchlor Process not only makes possible an oil more highly refined and homogeneous but with a greater resistance to oxidation and deterioration, longer life is insured and less make-up oil is required.

Gulf Oil Corporation · Gulf Refining Company
Gulf Building, Pittsburgh, Pa.

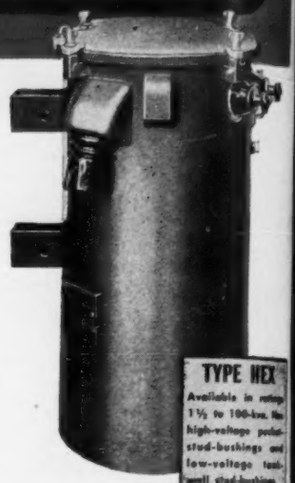
GULF INDUSTRIAL LUBRICATION

Back the attack with **more** War Bonds and Stamps

Wagner
DISTRIBUTION TRANSFORMERS
are standardized in accordance with E. E. I. - NEMA *Specifications*



TYPE HEBK
Standard in voltage classes above 5,000 volts. Has stud-type high-voltage cover-bushings and stud-type low-voltage tank-wall bushings.



TYPE HEX
Available in ratings 1½ to 100-kva. Has high-voltage pedestal-stud-bushings and low-voltage tank-wall stud-bushing.

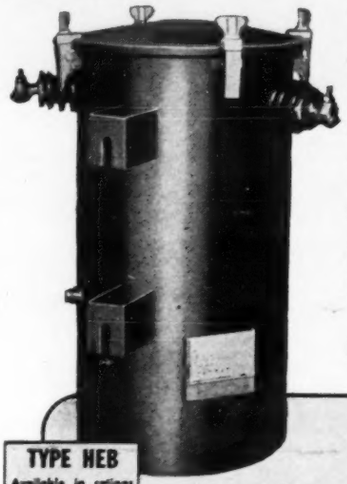
WAGNER'S complete line of single-phase, 60-cycle, pole-type distribution transformers (rated 100-kva and below, high-voltage 15,000 volts and below, low-voltage 600 volts and below) are now built in accordance with E.E.I.-NEMA standards.

Standardized mechanical features include interchangeable mountings, bushing location, number of bushings, terminal connectors, internal connections, nameplate and pad for users' data, external grounding provisions, drain plugs, oil-level marking, and terminal insulating caps when required.

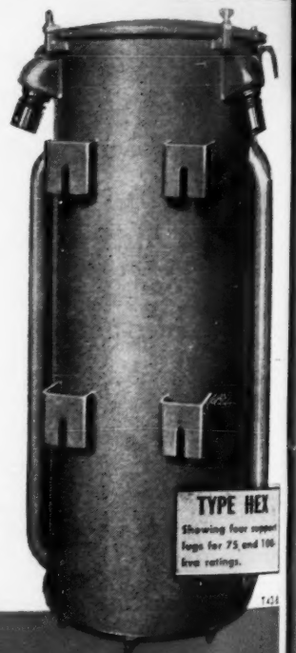
Ratings of 1½ to 50-kva are designed for direct-pole mounting through the use of two support lugs with standardized spacing. These support lugs are also used for attachment of "T"-crossarm hangers. Ratings of 75 and 100-kva have four support lugs for crossarm hangers, or accessory brackets for direct-pole mounting.

Stipulated electrical features include standardized high- and low-voltage ratings, kva ratings, polarity, low-voltage connections and taps.

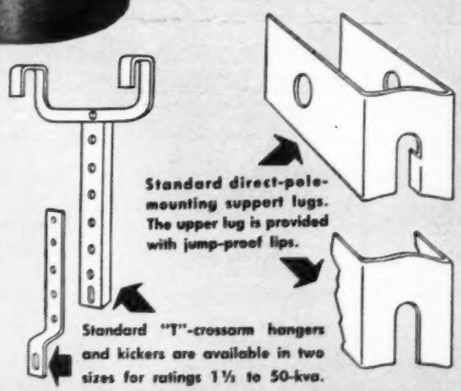
Illustrated are available types of Wagner distribution transformers.



TYPE HEB
Available in ratings 1½ to 100-kva. Has sidewall-stud-type high- and low-voltage bushings.



TYPE HEX
Showing four support lugs for 75 and 100-kva ratings.

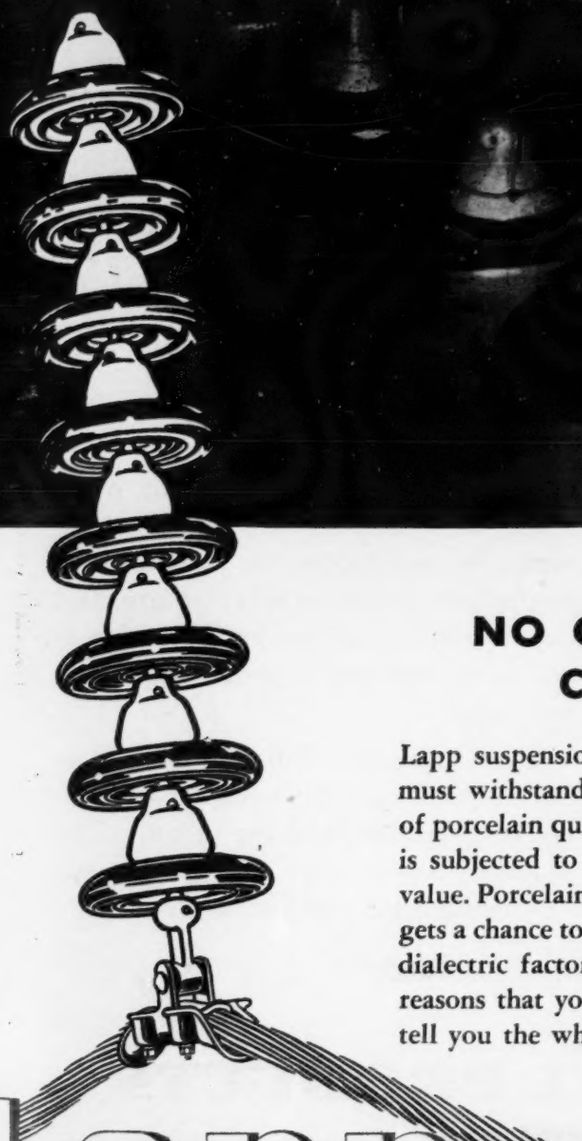


Standard direct-pole-mounting support lugs. The upper lug is provided with jump-proof lips.

Standard "T"-crossarm hangers and kickers are available in two sizes for ratings 1½ to 50-kva.

COMPLETE INFORMATION WILL BE MAILED ON REQUEST

Wagner Electric Corporation
ESTABLISHED 1891
6400 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS



NO QUESTIONABLE PORCELAIN CAN SURVIVE THIS TEST

Lapp suspension insulator units, before being approved for shipment, must withstand the Overpotential Test, the industry's most severe test of porcelain quality. Its rim immersed in oil to prevent flashover, the unit is subjected to 60 cycle current at voltage higher than rated flashover value. Porcelain not up to the Lapp standard, punctures in this test, never gets a chance to fail on your lines. Units that survive are assured a definite dialectric factor of safety. The Overpotential Test is one of the many reasons that you do better with Lapp insulators on your lines. May we tell you the whole story? Lapp Insulator Co., Inc., LeRoy, N. Y.

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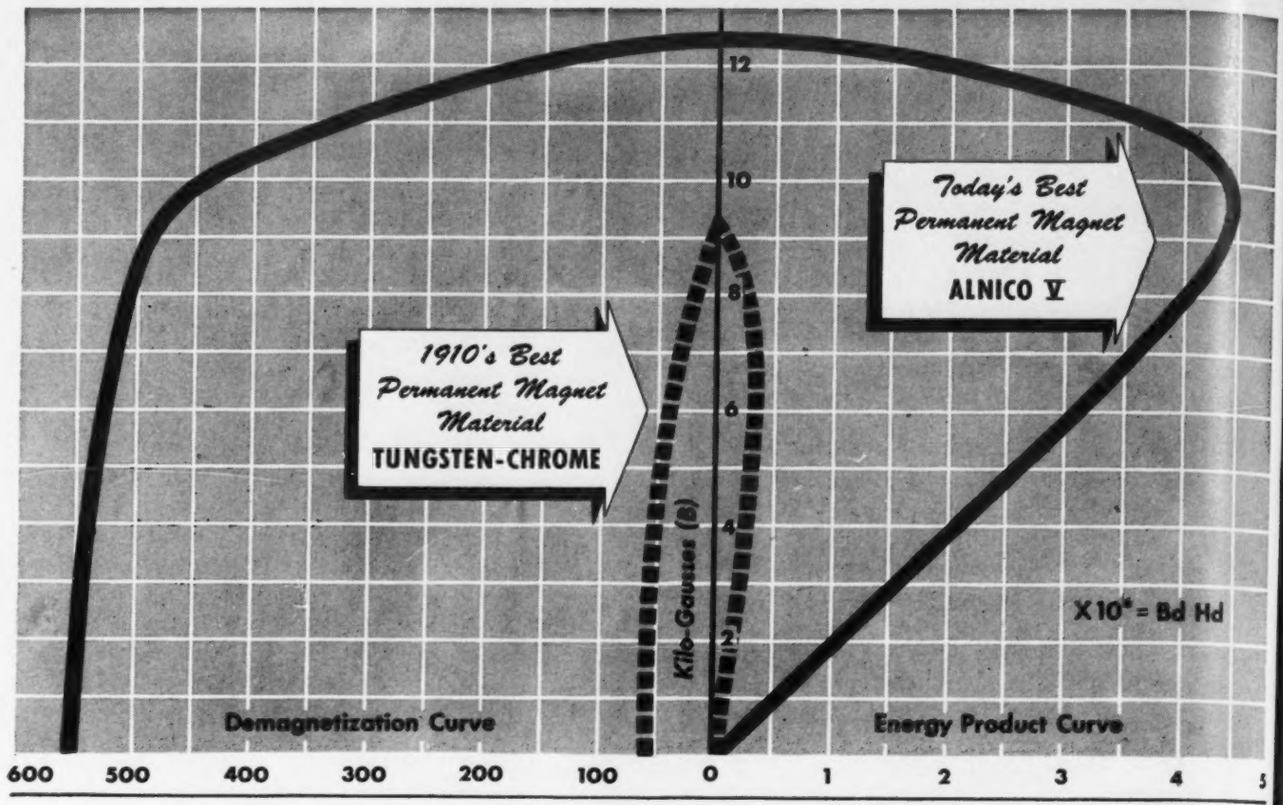
Better Porcelain • Better Insulators

PERMANENT MAGNETS MAY DO IT BETTER



Increased Energy Has Made Possible Many New Uses for Permanent Magnets!

Today's permanent magnets of Alnico V have a stored energy ten times that of 1910's tungsten-chrome magnets!

This energy increase, the economies in bulk and weight resulting from it, plus significent advances in design and fabrication, have made it possible to use permanent magnets in countless *new* products.

Specializing in this *one* industry for 33 years, our organization has assumed a leading role in permanent magnet developments. We've constantly originated new shapes, new applications, and new techniques in metallurgical control and precision manufacture. This experience should prove invaluable to you in the solving of your engineering problems.

Our engineers will be pleased to consult with you. Write us, on your letterhead, for the address of our office nearest you—and a copy of our 30-page "Permanent Magnet Manual".

Back the Attack with War Bonds!

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★ SPECIALISTS IN PERMANENT MAGNETS SINCE 1910 ★

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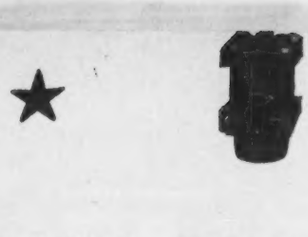

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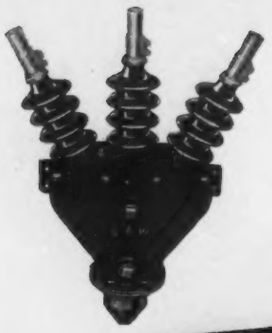
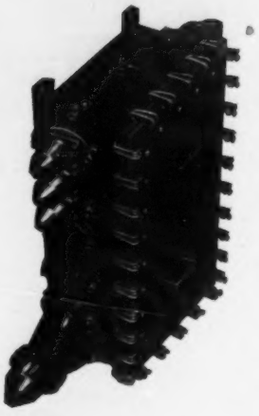


THE NERVES OF AMERICA'S MIGHT!

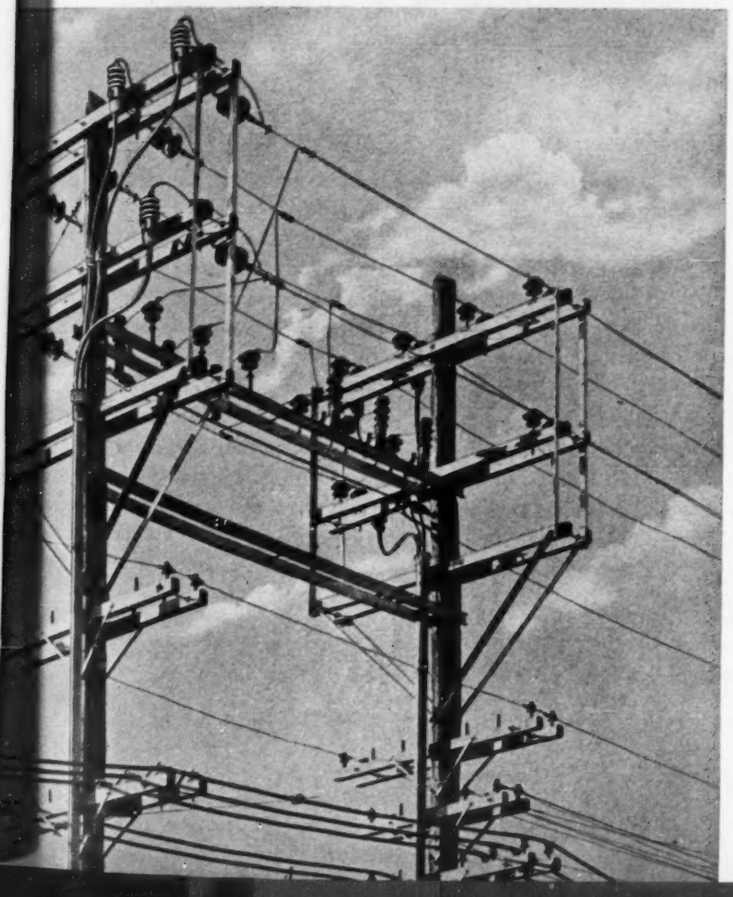
Through a vast network, inconceivable in magnitude, power hums to millions of tools and machines. Tools that ask no rest. Power that hums without ceasing — hums a hymn of doom for tyranny.

Throughout America's electric systems are G & W Products — Potheads, Boxes, Oil Switches, Oil Fuse Cutouts and other cable devices. You find them posted at vital points, quiet inconspicuous sentinels of efficiency obeying orders dependably — good soldiers.



Experienced engineers and maintenance executives know G & W of old — as a name symbolic of quality and thoroughness; a name standing for sturdy performance that eliminates dangerous interruptions; a name rightly identified with the nerve system of America's military might.

G & W ELECTRIC SPECIALTY CO., 7780 DANTE AVE., CHICAGO, ILL.
In Canada • • POWERLITE DEVICES, LTD., TORONTO and MONTREAL



G&W

ELECTRIC SPECIALTY COMPANY

CABLE TERMINATING, SECTIONALIZING AND PROTECTING EQUIPMENT

STARTING JANUARY 18TH

IT'S UP TO YOU!

STARTING January 18th, it's up to you to lead the men and women working in your plant to do themselves proud by helping to put over the 4th War Loan.

Your Government picks you for this job because you are better fitted than anyone else to know what your employees can and should do—and you're their natural leader. This time, your Government asks your plant to meet a definite quota—and to break it, *plenty!*

If your plant quota has not yet been set, get in touch now with your State Chairman of the War Finance Committee.

To meet your plant quota, will mean that you will have to hold your present Pay-Roll Deduction Plan payments at their peak figure—*and then get at least an average of one EXTRA $100 bond from every worker!*

That's where your leadership comes in—and the leadership of every one of your associates, from plant superintendent to foreman! It's your job to see that your fellow workers are sold the finest investment in the world. To see that they buy their share of tomorrow—of Victory!

That won't prove difficult, if you organize for it. Set up your own campaign right now—and don't aim for anything less than a 100% record in those *extra* $100 bonds!

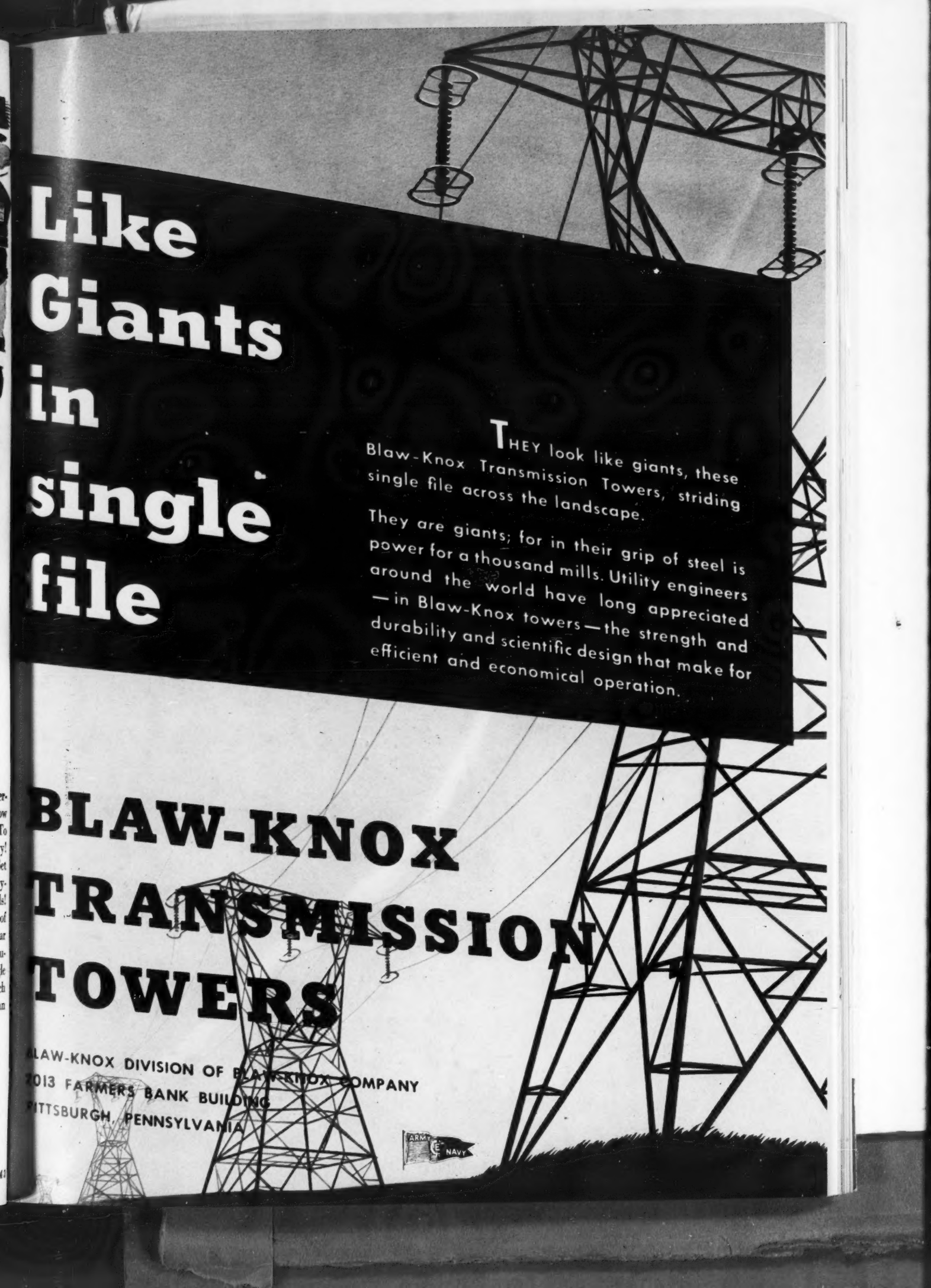
And here's one last thought. Forget you ever heard of "10%" as a measure of a reasonable investment in War Bonds under the Pay-Roll Deduction Plan. Today, thousands of families that formerly depended upon a single wage earner now enjoy the earnings of several. In such cases, 10% or 15% represents but a paltry fraction of an investment which should reach 25%, 50%, or more!

Now then—Up and At Them!

Keep Backing the Attack!—WITH WAR BONDS

This space contributed to Victory by ELECTRICAL WORLD

This advertisement prepared under the auspices of the United States Treasury Department and the War Advertising Council


Like Giants in single file
THEY look like giants, these Blaw-Knox Transmission Towers, striding single file across the landscape.
They are giants; for in their grip of steel is power for a thousand mills. Utility engineers around the world have long appreciated — in Blaw-Knox towers — the strength and durability and scientific design that make for efficient and economical operation.
BLAW-KNOX TRANSMISSION TOWERS
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NAVY

To Keep Away From Rust + To Keep Wiring Safe

ENGINEERS SPECIFY "SHERARDUCT" RIGID STEEL CONDUIT

- Sherasolution which impregnates zinc
- Surface zinc over the alloy may be as thick as desired
- Alloy composed of surface steel and zinc making a new metal, zinc-steel alloy
- "Premium" steel costing more per ton than ordinary merchant pipe

Sherarduct

* Threads as well as interior have equal protection with the outer wall of the conduit.

National Electric

Products Corporation

Pittsburgh, Pa.

Load Research

How much does the electric utility industry know about individual loads—their probable revenue, their net revenue productivity, their service cost?

How much does the electric utility industry know about the value of electric service to customers, about the vulnerability of load to competition, about the cost of central station service in relation to the willingness of customers to pay?

What means has the electric utility industry for studying new loads or for developing new load possibilities on its own initiative?

These are not new problems. They have grown up with the industry. Many studies have been made by individual companies, by committees, and some by research organizations, but many of the data have been fragmentary and for that very reason inconclusive, besides, by this time, being so old as to have lost much validity because of changed conditions.

The world of tomorrow will need facts upon which to plan. Business is becoming more and more convinced that it can expand faster with more assurance of success if it first has facts that have been tested by research.

Take the most universal load, lighting. What revenue will be received from a kilowatt of added lighting in the different customer classifications? In residential lighting, for instance, there is a large difference of opinion.

One of the burning questions of the day, and about which a lot of opinion is being expressed, is post-war diesel, and other customer-owned power competition. Does the rate schedule contain the only way to meet this competition? And the same thing holds true for other forms of competition, such as gas in the domestic customer field.

Can not loads be found that will make rural lines pay a profit, even if only incrementally? Does street and highway lighting, which is using less energy now than it did in 1930, have to be a "necessary evil," or can it become once more an attractive and growing load?

Several large chunks of war load are going to take a long time to replace because we do not know enough about new loads nor do we have any organized way of finding out. At the same time, the higher load factor of three-shift operation is going to fall back because we do not know how to prevent it.

In the residential field, where we have proposed a five-year goal of double-the-average-customer usage, with an ultimate in less than twenty years of as much per customer per month—1,000 kw.-hr.—as is now used per year, the question is how. What are we going to use for load, we are asked.

To find answers to even some of the problems of profitable load is going to take time and money. Therefore, the planning should start as soon as possible, and we suggest as the kernel of such planning a load-research program financed by a research fund and operated in such a way that numerous investigations could be carried on simultaneously by recognized research organizations, either universities or others, under some central body.

Economical Transformer Set-up for War Housing Development

Load study reveals practicability of serving 600 dwelling units having ranges, refrigerators, air circulators and smaller appliances, lighting, radio, etc., on basis of 0.75 kw. transformer capacity per customer and 1.35 transformer kva. per kw. demand

LESTER H. FAULKINGHAM, Distribution Engineer, New Hampshire Gas & Electric Co., Portsmouth

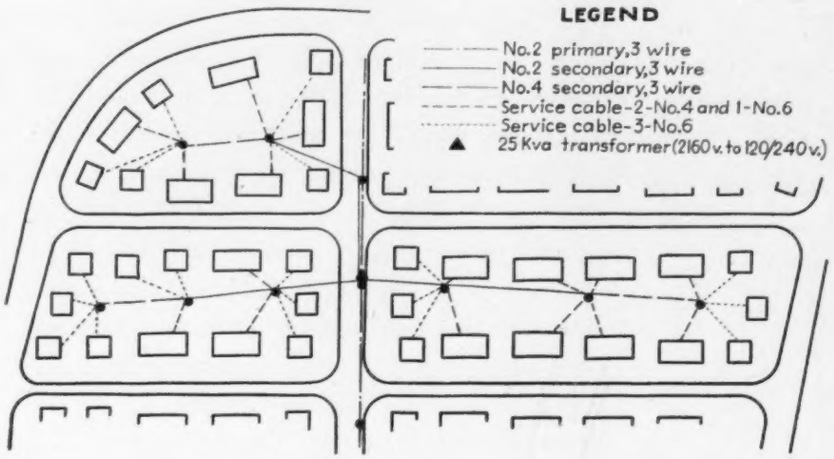

FIG. 1—Diagram of section of load area, when 52 dwelling units were served by one 25-kva. transformer

VERY SMALL transformer capacity per customer, resulting from high diversity and from low demand, as against large connected load, was required in a temporary war housing project recently completed. The project was first planned to include 400 dwelling units, each containing a 7,800-watt range, a ¼-hp. motor driving an air circulator and approximately 340 watts of lighting, all as permanent fixtures, to which were to be added such other electric appliances as the occupant might bring.

Anticipating a comparatively high demand, 1½ kva. of transformer capacity was allowed for each dwelling unit, and in consequence 22 25-kva. "completely self-protecting" transformers were procured for the job. The original idea was to install these units in pairs, connecting primaries and secondaries of each pair in parallel to give a total capacity of 50 kva. to serve each load area (25-kva. transformers were chosen rather than 50-kva. units since they would better fit into post-war distribution requirements in other parts of the system). Soon after construction had started, however, the company was notified that the project would be enlarged by 50 percent, making a total of 600 dwelling units to be served.

In order to keep capital investment to a minimum, since revenue could be expected only for the duration of the emergency, it was decided to install a single transformer rather than a pair at each load center, and subsequently to add the second unit in parallel only where and when found necessary. Accordingly, a total of 16 transformers were installed, keeping six units in stock as a reserve.

As soon as a sufficient number of homes were occupied, spot check-ups of transformer loading were made. One transformer which was found to have a 40 percent overload was selected for further investigation. A diagram of this load area is shown in Fig. 1. The red signal lamp on this transformer, which would light if the transformer were overheated, had not become lighted. Neither were any of the other transformer signal lamps lit. A house-to-house canvass was made covering the 45 customers served from this transformer to determine the magnitude of the connected load and, incidentally, to find the appliance saturation.

Test meters were also installed in 12 of these homes so as to measure the individual consumption of ranges, air circulators and refrigerators. The consumption of lights and other miscellaneous appliances lumped together was accounted for by the difference between the sum of the foregoing and the registration of the regular billing meter of each customer. It was assumed that the data obtained from these 12 customers, chosen at random, held true on the average for the whole development. The results of this investigation are shown in Table 1.

The average hourly load per customer for the month was found to be 243 watts or 2.2 percent of the average connected load.

A recording ammeter was also used on successive days of one week to obtain individual daily load curves for five customers connected to the above-mentioned transformer. On the following week the daily load characteristics were obtained for the transformer supplying 45 customers and also for the primary lines supplying

the whole development. The most pertinent data thus obtained are summarized in Table II.

Low Short-time Peaks

Figs. 2 and 3 give typical daily load curves for the 25-kva. transformer and for the whole development respectively. Derived from this load study is the surprising fact that the average simultaneous short-time peak demand per customer is only 1.05 kva. for those served from the one transformer and 0.645 kva. per customer for the whole department.

Transformer Loading Is High

On Thanksgiving Day two of the transformer units in the development showed a red light, indicating serious overload. Again on Christmas Day the same two showed a red light and one of them tripped out, causing an outage of approximately half an hour to 67 customers. Shortly after this experience two additional transformers were installed to relieve this condition of extreme overload. These two added units were not placed in parallel with the existing overloaded transformers as originally planned, but were used to supply two new load areas created by a little revamping of the secondary system. Since this change no transformer is serving more than 42 dwelling units, and as a consequence none has tripped out or even shown a red light due to normal overload. The total transformer capacity (450 kva.) is now only 16 percent greater than the short-time demand for the whole development and is only 6.8 percent of the total connected load.

At the main switch of the customer farthest from the last transformer on the primaries a voltage drop of less than 7 percent exists. The center of this development is approximately one mile away from a 1,500-kva. voltage regulating automatic unit substation which also serves two towns. The experience gained in trouble-free operation of these transformers, under conditions of daily recurring short-time over-

Table I—Customer Load Data

Appliance	Percent Saturation	Average Capacity		Average Monthy Consumption	
		Watts	Percent of Total	Kw.-Hr.	Percent
Range	100	7,800	70.6	81	46
Air circulator	100	228	2.1	33	19
Refrigerator	78	267	1.9	20	12
Electric iron	100	800	7.2		
Radio	117	80	0.9		
Toaster	80	800	5.8		
Washing machine	76	300	2.1		
Vacuum cleaner	36	150	0.5	41	23
Mixer	29	200	0.5		
Coffee maker	27	500	1.2		
Waffle iron	13	1,000	1.2		
Sewing machine	7	75	0.05		
Lights	100	660	6.0		

Table II—Housing Development Load Characteristics

	Average for One Customer	25-Kva. Trans. 45 Customers	Whole Development 574 Customers
Connected capacity—Kw.	11.03	496	6,337
Average load—Kva.	0.294	13.3	169
Short time demand—Kva.	4.9	47.3	370
15-Minute demand—Kva.	3.6	37.6	332
30-Minute demand—Kva.	3.1	33.8	320
Daily load factor, percent	6.0	28.0	45.6
Diversity Factors:			
For short time demand	1.00	4.66	7.60
For 15-minute demand	1.00	4.31	6.32
For 30-minute demand	1.00	4.13	5.55

Table III—Comparison of Housing Groups

	All-Electric 600-Home Development	Gas-Electric 800-Home Development
Transformer capacity per customer	750 watts	488 watts
Average load per customer	243 watts	120 watts
Average simultaneous demand per customer	554 watts	318 watts
Kw.-hr. month per transformer kva.	233 kwh.	182 kw.-hr.
Transformer kva. per kw. demand	1.35 kva.	1.53 kva.

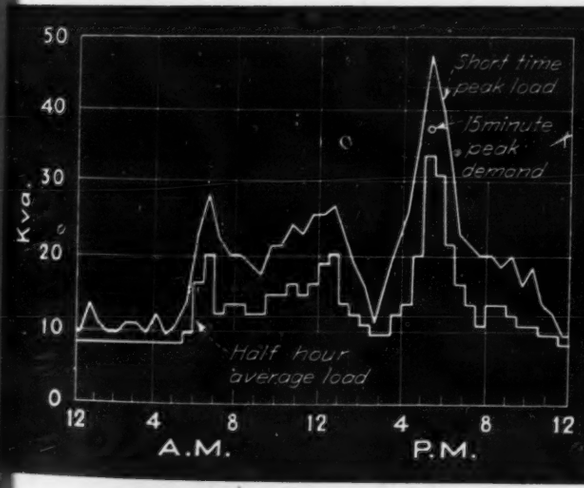

FIG. 2—Load characteristics (March 9) imposed by 45 customers on one 25-kva. transformer

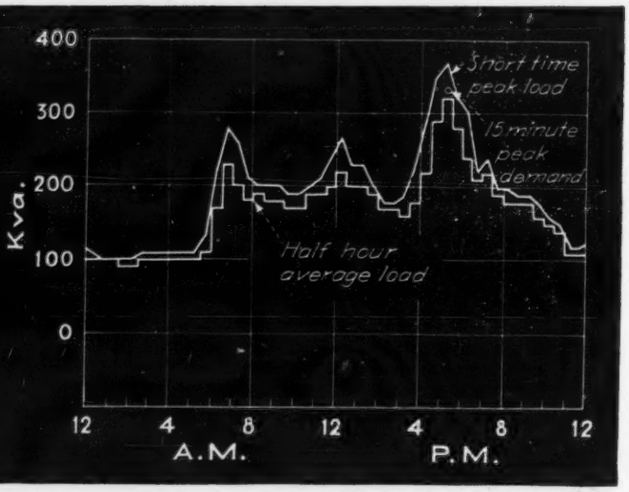

FIG. 3—Load characteristics (March 6) of primary circuit serving 574 customers

FIG. 4—Typical transformer mounting (25-kva. unit) on pole in load center serving group of housing units through backyard secondaries

loads, has already permitted a marked reduction of the transformer capacity per customer in other parts of the system without fear of impairing quality of service. Thus utilizing the time-thermal capacity of transformers has effected economies not previously thought possible.

In contrast with the above development there is another local housing development comprising some 800 dwelling units having gas ranges instead of electric, but otherwise very similar as to electrical appliances. However, the electrical construction in this development was done by a private contractor to government specifications and is representative of the company's previous orthodox method of construction. A total of 390 kva. of transformer capacity (26 15-kva. units) is used to serve 800 customers whose combined 15-minute demand was 254 kw. for the season of the year corresponding to that during which the data on the 600-home development was taken.

Spinning Capacity and Loc

C. WASSERMAN, Assistant to Electrical Engineer
Consolidated Gas, Electric Light & Power Company of Baltimore

THE Consolidated Gas, Electric Light & Power Company of Baltimore and the Pennsylvania Water & Power Company recently put in service, at their respective load dispatcher's offices, graphic meters which record both the spinning capacity and the combined system load on duplicate charts (Fig. 1). The purpose of this record is to provide a convenient means of determining at any time the amount of operating spare capacity available on the system. Multi-point potentiometer recorders are used, recording the spinning capacity and system load at selected intervals.

Potentiometers in the respective load dispatcher's offices are essentially sampling devices and substantially record the same indications, although the timing of the recording of the indications and the pattern of capacity and load sampling are slightly different. The recorder at the Consolidated's load dispatcher's office prints alternately every 15 seconds spinning capacity and system load. The time intervals between successive spinning capacity measurements or successive load measurements are therefore approximately 30 seconds. It was thought desirable to record the system load averaged over a 30-second period rather than record the load at the instant of measurement.

Spinning Capacity Telemetered

System spinning capacity measurement is obtained by manually adjusting the amount of resistance connected in a constant direct-current source producing a current proportional to the spinning capacity (Fig. 2). This current is passed through a resistor and the voltage drop across it is metered by one point of the recorder. Spinning capacity on the system is controlled by the two dispatchers, one controlling steam generation and the other hydro generation. Each dispatcher has control of a variable resistor in the capacity measuring circuit, which he adjusts to correspond

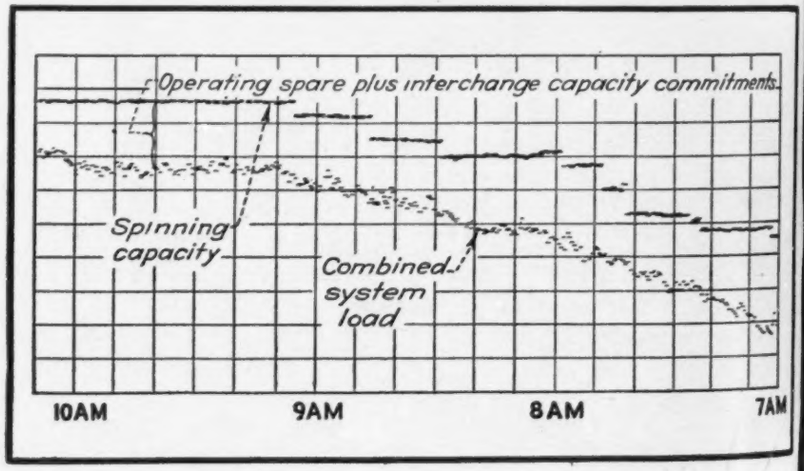

FIG. 1—Meter chart at Baltimore load dispatcher's office shows excess of spinning capacity and interchange commitments over totalized load

oad on Same Chart

Combined record enables operators of interconnected systems to observe the margin of operating spare capacity — Accuracy of combined load curve is within two percent

to the generating capacity he has placed in service. A d.c. milliammeter with scale marked in megawatts is connected in series with each resistor as an aid for the proper setting of the resistors.

Combined system load measurement is obtained from a current-balance telemetering system which meters all the various components feeding the system. Output currents of the various telemeters are totalized and are likewise passed through a resistor (shown schematically in Fig. 3). This resistor, the voltage of which is proportional to the instantaneous total load, is connected to a condenser-resistor storage network which gives the desired 30-second load average.

Accuracy

Accuracy of the combined system load curve on a 24-hour basis, determined at various times by integration and comparison with the watt-hour meter readings, is well within 2 percent.

At present the difference between the two graphs on the chart represents the sum of both the operating spare capacity and the interchange capacity commitments to other systems. Therefore, the load dispatcher is required to compensate the chart readings by the amount of commitment to obtain the available spare capacity.

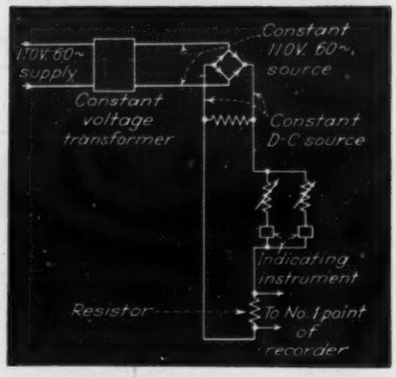

FIG. 2—Each dispatcher adjusts resistor in rectifier circuit until milliammeter (graduated in megawatts) registers the amount of spinning capacity at his station; this value is telemetered and totalized

Application of an additional graph on the chart representing the spinning capacity less the interchange capacity commitments is under consideration. This additional curve will serve as a means of obtaining a continuous direct check on the operating spare. With this addition, the chart will record three graphs — (1) spinning capacity, (2) spinning capacity less interchange capacity commitments and (3) combined system load. The combined system load would be recorded every 30 seconds by one point of the recorder, as on the present chart, while the two capacity curves would be recorded alternately every 30 seconds by the other point.

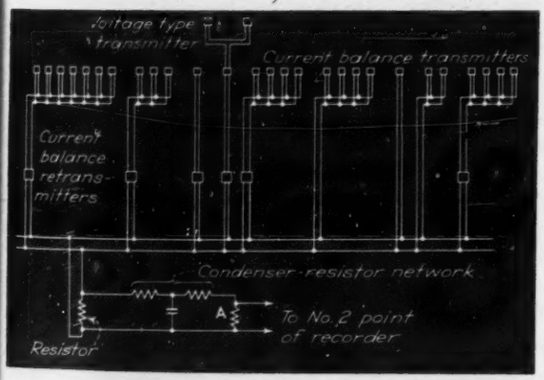

FIG. 3—Current-balance telemetering and totalizing transmits system load; condenser-resistor network "stores" values over 30-second period to create average at resistor A

Crossarm Braces Into Side Brackets

Release for scrap of as much metal as possible is a great help toward winning the war, but an even greater help is to employ in necessary purposes metal that otherwise would have only scrap value. That is the reason behind the conversion of crossarm braces into spool insulator brackets in the shop of the Virginia Electric & Power Company at Richmond. Many large war housing projects have been and are being constructed in the company's service territory and thousands of these brackets are required.

The braces are 28 in. long. Each makes two brackets—cut in half, holes punched out and shaped on a jig into a square U about 5 in. across. The stud for holding the spool insulator in the jaw of the bracket is half of an old crossarm spacing bolt, a nut jammed on the threaded end and the other drilled for a holding wire.

The resulting spool insulator bracket assembly is not as good as the manufactured article. The galvanizing is not improved in the bending operation. Neither does an old spacing bolt make the best kind of an insulator stud. But the home-made bracket does hold up the wires and it will hold them up until proper line hardware again becomes freely available.

War Load Problems Studied on D. C. Board

Improved calculator affords amply accurate information regarding faults, kilowatt and kilovar distribution, voltage regulation and interconnection changes — Supplements a.c. board

V. E. HILL and W. G. DEMPLER, Duquesne Light Company, Pittsburgh, Pa.

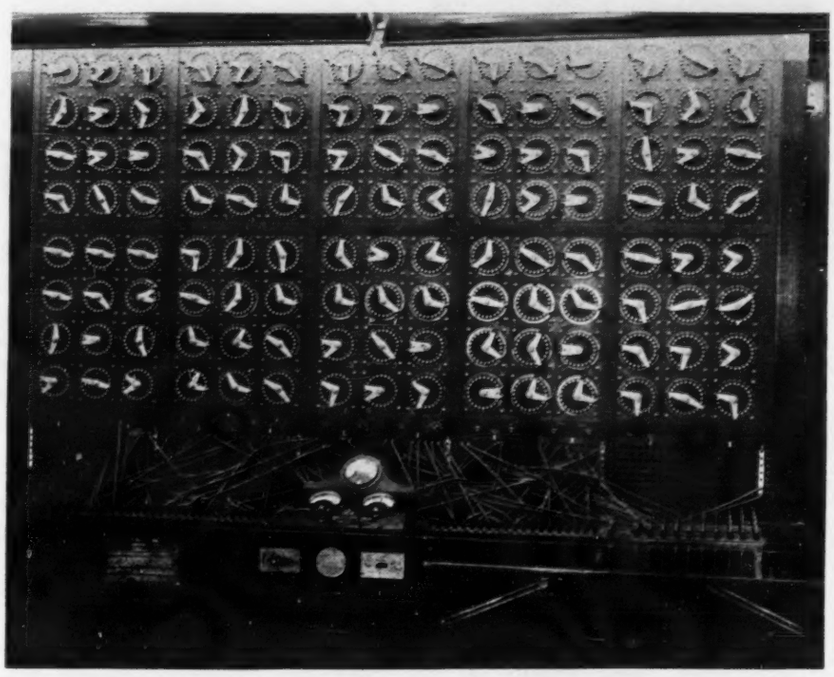

FIG. 1—Typical network set up on improved d.c. calculator. The added radio-type resistors are in a row just above the cords

IN SPITE of the increased popularity of a.c. boards, there are many d.c. calculators in daily use performing many useful functions. Priorities and shortages of critical material have made it absolutely essential to expand and operate systems with a minimum of space capacity and in general with past high standards of service continuity. We have used our d.c. calculator for studying short-circuit currents, load distribution (both power and reactive), voltage regulation, effect of interconnections and many other system problems, including the effect of voltage regulators, phase shifters and condensers.

In this article we wish to point out the improvements we have made to our d.c. calculator, which is one of the earlier models, and some of the methods we use, all of which expedite the solution of these wartime problems.

It is not intended that the d.c. board should replace the a.c. calculator (we frequently use the latter) or that the methods described herein are applicable to all systems. In general, it might be said that where the ratio of resistance to reactance of the lines on the system involved is less than one-third the d.c. board can be used. While various special schemes for obtaining greater accuracy on the d.c. board have been published from time to time they usually involve considerably more time than the procedure described herein.

Original Board

Originally the board consisted of 156 double-arm contact-type resistor units (Fig. 1). Each unit consisted of two resistors in series, one of 480 ohms, tapped in 40-ohm steps from 80 ohms to 480 ohms (total of eleven contacts), and the other a 4,000-ohm resistor with a tap every 400 ohms (also eleven contacts). However, for simplicity each resistor is marked in values divisible by 40, that is, 2, 3, 4, etc.; hence any value from 2 to 112 can thus be obtained.

The board contained the usual jacks and plugs for setting up any network, and while individual keys were available for reading the current in any circuit, no arrangements were available for reading branch voltages. Metering consisted of a voltmeter and a zero-center ammeter with proper scales and shunts to give ranges of 25, 100 and 500 milliamperes. Direct current was obtained from a motor-generator set with both a coarse and a fine rheostat for manual control of the d.c. voltage.

Original resistor units did not permit very low settings or close enough settings for low values. Consequently

we replaced the 4,000-ohm resistor of ten units with a 220-ohm resistor tapped at 20-ohm steps, thus obtaining in terms of board markings (*i.e.*, dividing by 40) a range of 0.5 ohm to 17.5 ohms in half-ohm steps.

Milliammeter Added

Many of our studies involved a wide range of loads, which meant very small readings on even the 25-ma. scale of the milliammeter. Small currents could be secured only by connecting numerous resistors in series. This problem was overcome by installing another milliammeter with a scale of only ± 5 ma. and by replacing ten of the 480-ohm resistors with 40,000-ohm resistors, tapped at 4,000-ohm steps. These high-resistance units are also useful for setting up parallel lines operating at less than base voltage.

These high-resistance units proved so useful that it was decided to add some more, but of a slightly different form. Ten radio-type resistors, each rated at 100,000 ohms, were installed in the space just above the jacks, as shown in Fig. 1. These resistors were connected to two adjacent jacks so that they could be used in the same manner as the regular board units. They are very convenient, and although it is not possible to obtain a given ohmic setting with this type of unit, this is no hardship, since it is our practice anyhow to obtain proper loads by current adjustment. Also, the existing voltmeter was not satisfactory for all purposes and it was replaced with a new 1,000-ohms-per-volt instrument. Furthermore, addition of a single-pole, double-throw switch (Fig. 2) made it possible to read the voltage on any bus by throwing the branch switch of any green cord on that bus.

Originally, the plugs were identified only by a number plate on the table between the two ends. When the plugs were inserted in the jacks for a network set-up, it was very difficult to trace the plug back through a maze of cords to identify it. Stamping the number on the sleeve of the plug made it very easy to "perform switching" and make other board changes.

Transfer buses for connecting certain jacks in each section together were restored after having been removed soon after the board was acquired. Lettering the sections clarifies the use of the circuit diagrams. Special illumination facilitated better use of the board.

New Uses for Board

It is believed that common practice is to work out current distribution in a complicated network, using either reactance or impedance. Current is converted to kw. or kva. by a fixed constant and consequently power factor is ignored. We believe that for a given system reactive can be fairly easily taken into account, as well as securing voltage on different parts of the system. Even voltage regulators and phase shifters can be represented.

Whether or not a d.c. board can be used to make these load studies is dependent upon the ratio of the resistance to reactance of the circuits involved. If the reactance is large as compared to the resistance, as it is with generators, transformers, reactors and high-voltage overhead lines, the d.c. board can be used. If the ratio of the resistance to reactance is greater than one-third, the d.c. board probably should not be used (see Fig. 3).

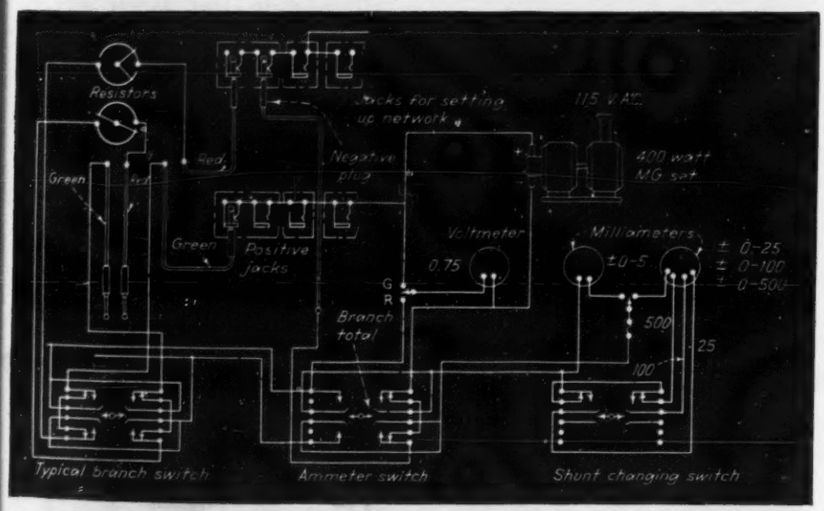

FIG. 2—With voltmeter switch thrown to resistor (R) position, the voltage of the "green" end of any resistor is obtainable; G is for generator voltage

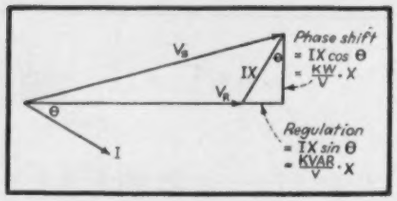

FIG. 3—Phase shift is proportional to power load times circuit reactance; voltage regulation closely proportional to reactive load times circuit resistance

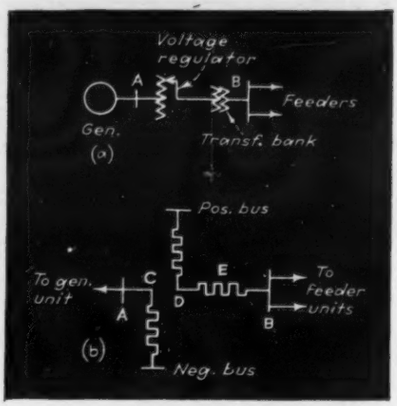

FIG. 4—Equivalent (b) of voltage regulator (a). Current through C to negative bus is maintained equal to current supplied from positive bus to D. Voltage difference between C and D is made equal to the voltage boost of the regulator

When making power and reactive load distribution studies and where voltage is also desired it is often advisable to adjust the circuit reactance as set up on the calculating board. Since the reactive current flow on a power system is controlled mainly by the voltage, this board-setting adjustment is made only for a reactive load distribution, at which time voltages are also read. For each phase:

Approxmate regulation

$$= IZ = I_{\text{Reac.}} \cdot X + I_{Pr.} R$$

$$= \frac{1}{\text{Kv.}} (\text{Kvar} \cdot X + \text{Kw} \cdot R)$$

$$= \frac{1}{\text{Kv.}} \left(\text{Kvar} \cdot X + \frac{\text{Kvar}}{\text{Kvar}} \cdot \text{Kw} \cdot R\right)$$

$$= \frac{1}{\text{Kv.}} \text{Kvar} \cdot \left(X + \frac{\text{Kw}}{\text{Kvar}} \cdot \text{R}\right)$$

If the load power factor is 90 per-

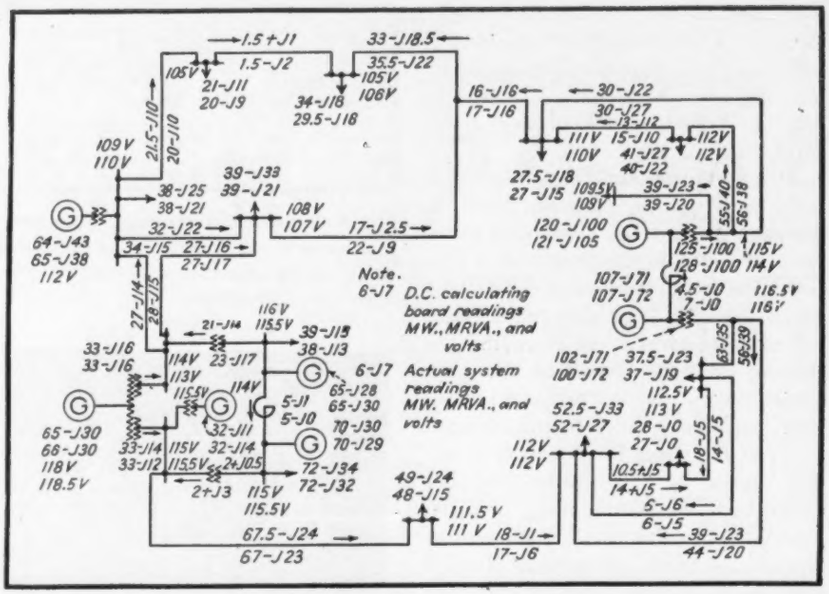

FIG. 5—Upper figures at each point are the values derived from the d.c. board studies. The lower figures are the actual system readings; the agreement is good

cent the ratio Kw. is equal to approximately 2, and then

$$\text{Regulation} = IZ = \frac{1}{\text{Kv.}} \cdot \text{Kvar}\ (X + 2R)$$

Reactive Determinations

The first step is to determine the kw. distribution using reactance values of lines and transformers. The units representing generators and loads are then adjusted to obtain proper load on each. The resultant current flow in the resistor units representing various lines and transformers is then proportional to the kw. loading of the system.

The next step is to obtain a reactive load distribution. If it is not desired to measure the voltage, then the reactive distribution can be obtained by simply repeating the procedure for the kw. distribution, only using kvars. instead of kw. If, however, as is generally the case, it is desirable to read bus voltages, the board units representing the various circuits should be readjusted to values of $X + 2R$.

Generally what is done is to adjust the reactive on the loads and the voltage on the generators to their desired values, allowing the reactive load on the generator to vary within limits. Then the current in the various circuits is proportional to the reactive load of the circuits, while the voltage at any bus can be measured by reading the voltage of any green cord tied to that bus. By combining the kw. and kvar. readings, the kva. or power factor can be easily calculated.

If there are any voltage regulators or transformers with odd ratios on the system, their effect can be duplicated on the board set-up by one of two methods. A voltage boost (or buck) either from a voltage regulator or a transformer with an odd transformation ratio has the effect of causing a circulating current, practically entirely reactive, to flow through the system. To measure this on the analyzer all the loads and generators are first disconnected and then a voltage proportional to the voltage boost of the regulating equipment is put in the circuit in series with the transformer or regulator. The resultant current flow will then be proportional to the circulating kvar. caused by this voltage, which can then be superimposed on the original reactive load distribution. The ratio of the applied voltage to the circulating current also determines the loop reactance or impedance.

Phase Shifter

Another and in general more satisfactory method to obtain this same result is shown on Fig. 4. Suppose, for example, the original circuit included a voltage regulator (Fig. 4). This would be set up on the calculating board during the reactive load tests (Fig. 4), buses A and B being the equivalent points in the two cases. This method has the advantage that the resultant current flow throughout the network is proportional to the system reactive flow, including the effect of the regulator.

A phase shifter on a system has the effect of a circulating power through the system with very little reactive. On the network analyzer this effect can be shown when making the kw. load distribution by arbitrarily increasing the load through the resistor unit representing the phase shifter by an amount equal to the power shifted. This may be done by changing the resistance of the unit or by a scheme similar to that used for the voltage regulator. The actual amount of power circulated by a given quadrature voltage can readily be calculated from the loop impedance previously mentioned.

A condenser can be shown as an additional generator supplying only reactive load to the system. Its effect will be felt only on the reactive distribution.

Accuracy

Accuracy of these methods as applied to the Duquesne Light Company system has been checked against actual system conditions and the agreement between the two has been very good (Fig. 5).

The greatest percentage deviations are for the lightly loaded lines, which usually give little concern and have a minor effect on the voltage drop. We have assumed here that the power and reactive loading is proportional to the current. This is true if the voltage drop (for power and reactive readings) is neglected. More accurate results could be obtained by making the line loading at any particular point proportional to the product of the voltage and the current at that point; however, in general this additional refinement is not required.

Two of the transformers (Fig. 5) have a very high magnetizing current, which effect can, of course, be readily represented on the board. They have been taken into account even though the diagram does not show it.

The analysis on Fig. 5 and several additional checks with various generator loadings and various lines out of service can be made in a day, all with sufficient accuracy for the specific purpose in mind.

Inductive Heating Effects in Ferrous Switchgear Parts

Substitution of ferrous metals for copper and aluminum parts close to conductors focuses attention on inductive heating problems — Tests show that below 600 amp. ferrous fittings can be used almost indiscriminately; to a limited extent between 600 and 3,000 amp.

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THE high-tension industry has always been very free in its use of non-ferrous materials, almost all live parts being so constructed. As a matter of wartime conservation, it can be successfully shown that inductive heating does not prohibit the substitution of ferrous metals for copper and aluminum members close to conductor in many cases. Other detrimental factors, such as electrolytic action between dissimilar metals, are present when galvanized ferrous members are used next to non-ferrous parts. These, however, are decidedly secondary to the conservation problem.

In general, little precaution need be taken against magnetic heating up to 600 amp. and steel parts can be used almost indiscriminately. From 600 to 3,000 amp. the problem must be given careful consideration and non-ferrous parts must be used in conjunction with ferrous parts. Above 3,000 amp. all parts should be non-ferrous.

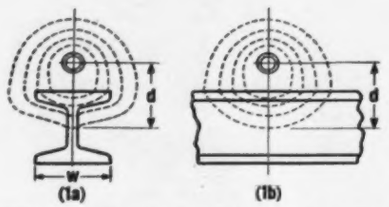


FIG. 1—Inductive heating is dependent upon the relationship between the ferrous section and conductor

With conductor parallel to beam (a) ferrous part of flux path is smaller than (b), where it is at right angles and losses and heating are greater.

Basic Theory

Several factors govern the inductive heating of ferrous parts. The closer the part is to the conductor the more it will heat. Encircling a conductor with a ferrous ring leads to very high temperatures. Variations in permeability will change the rises. Thin sections will heat less than heavy sections. Orientation of ferrous parts in a magnetic field and the size of the part, which is really a special case of orientation, are other important considerations. Frequency is also important. All data given here are for 60 cycles. Higher frequencies give higher temperature rises.

Steel or iron parts which have their largest dimensions at right angles to the conductor will heat more than identical sections which have this dimension parallel to the conductor. To illustrate—a beam is used in Fig. 1 (a and b) as a sample section. With the conductor parallel to the beam, the ferrous part of the flux path is small. However, when the conductor is at right angles to the beam the flux path is in the steel to a greater extent; reluctance of the path around

* From a paper presented by the author at Southwest District Technical Meeting, A.I.E.E., April 30, 1943.

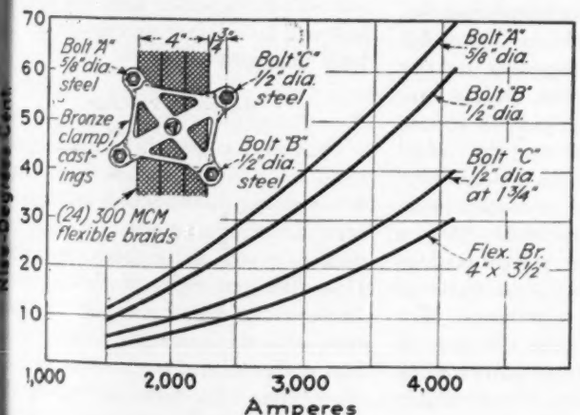


FIG. 2—Curves trace temperature rise in ferrous bolts of bronze clamp assembly, with increases in currents; largest and nearest bolts heat most

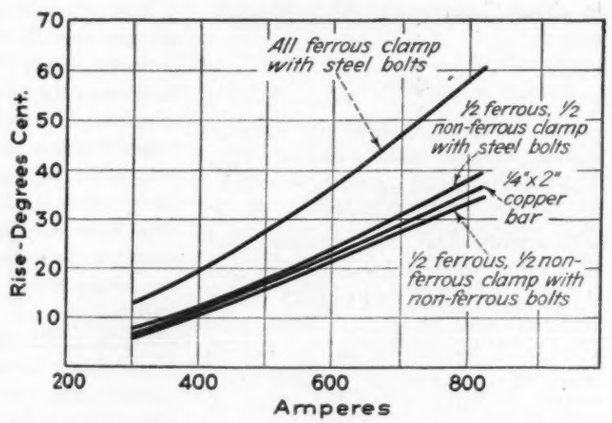


FIG. 4—Relationship between temperature rise of bus and its associated all-malleable iron clamp with steel bolts, for increases in current values

the conductor will be smaller; strength of the field will be increased and losses and heating will be greater. Also, when the beam parallels the conductor, the field will be uniform. At right angles there is a crowding of flux lines. All those lines which would ordinarily fall close to the beam will deflect instead of pass through it.

Should dimension "W" become large, as in a wide plate, a good part of the flux path would be in the plate and the temperature rise would approach that of the right-angle case. The parallel member may heat almost as much as the 90 deg. member if it presents a wide face in the right direction to facilitate the carrying of flux lines. When the ratio w/d is approximately one, temperature rise will be only about 20 percent as much as in a beam identically spaced but at 90 deg. to the conductor. When the ratio w/d equals three, the rise will be about 75 percent of the right angle case.†

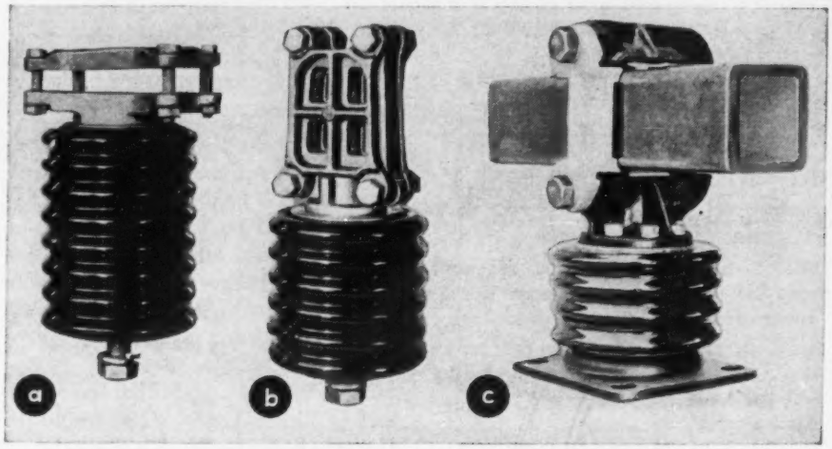


FIG. 3—Temperature rises below 45 deg. C. in the ferrous parts of bus supports are considered acceptable. Three support types shown are: (a) horizontal bar, (b) vertical bar and (c) square conductor

Bolts

Since bolts are used on various clamps, connectors, switches, etc., which go to make up modern switchgear, a test of the assembly in Fig. 2 is of interest. The conductor consisted of a group of flexibles 4 in. wide and 3½ in. thick. Top and bottom clamp castings were of bronze. Bolts were steel and placed as shown. Curves show rises at various currents. Bolt "A," ⅝ in. diameter and next to the conductor, showed the highest rise. Bolt "B," ½ in. diameter, next to the conductor, produced a smaller rise because of less material exposed to the magnetic field. Bolt "C," ½ in. diameter and moved 1¾ in. from the conductor, showed a considerably smaller rise, due to the increase in distance from the conductor. A bolt placed parallel and next to the conductor showed a rise of only a few degrees.

Heavier structural sections at the same distance from the conductor, at right angles and of longer length, will heat more than these bolts.

Another popular axiom in the high-tension field has been that for a.c. service bus clamps such as shown in Fig. 3 (a) can have one side of ferrous material but the other half of the clamp must be some non-ferrous material. For the higher capacities, all non-ferrous clamps were the rule.

It is generally agreed that rises below 45 deg. C. should be acceptable here, since only bus supports, and not contact surfaces or bus clamps, are involved. From a copper or bronze conservation viewpoint, the ideal clamp is one with both sides malleable iron or steel, and with steel bolts. This type of clamp presents almost a complete ferrous flux path, openings occurring only where thin coats of galvanizing act as separators. For currents up to 600 amp. (36 deg. C. rise) this combination proves satisfactory. The foregoing are maximum rises on any part of the bus clamp. Tests were made in a draft-free room. Steel bolts usually show the highest rises, since their permeability is higher than malleable iron. Likewise, where malleable iron is the only ferrous part on a clamp, it will have the highest rise.

The next logical step, still conserving as much copper as possible, would be malleable clamps with non-ferrous bolts. This combination is satisfactory up to 1,200 amp. (44 deg. C. rise). One ¼ x 4-in. bar was used as a conductor. The same clamp was ample at 200 amp. (45 deg. C. rise) on a conductor consisting of two ½ x 4-in. bars, and at 2,800 amp. (39 deg. C. rise) conductor, four ¼ x 4-in. bars. Half-and-half clamps with non-ferrous bolts showed considerably lower rises on the same busbar combinations: 1,200 amp. (27 deg. C. rise), 2000 amp. (29 deg. C. rise) and 2,800 amp. (26 deg. C. rise).

It should be kept in mind that in applications of this kind the openings in the ferrous path, as well as current carried, are of major importance. Identical clamps, consisting of malleable castings and non-ferrous bolts, will produce rises as shown above—44 deg. at 1,200 amp., 45 deg. at 200 amp. and only 39 deg. at 2,800 amp. This apparent contradiction is explained by the fact that the opening between the clamps (effective air gap) totals 3½ in. for 2,800 amp. (four 4 x 4¼-in. bars) against 1½ in. and ½ in. for the two other cases.

Note that the above combinations, while satisfactory for bus configurations given, are not necessarily correct for other configurations of the same ampere capacity. A non-ferrous bolt, used to break a ferrous path on a clamp, will be more efficient on two 2 x ¼-in. bars than on one ¼ x 4-in. bar. On the smaller bars the longer bolt will be a larger percentage of the total flux path.

Adjacent Fittings

Present-day urge is to load equipment and buses to maximum capacity. When doing this it is well to consider ferrous fittings adjacent to the conductor, as well as the conductor itself. How different types of clamps, such as shown in Fig. 2, vary in temperature with the conductor is shown in Fig. 4. Tests were made on one ¼ x 2-in. copper bar. Note that when the current was doubled from 400 to 800 amp. the rise differential between the bus and the all-malleable steel-bol

† "Temperature Rise and Losses in Solid Structural Steel," by O. R. Schuring and H. P. Kuehni, *Transactions* of A.I.E.E., Vol. XLV, 1926, page 184.

clamp climbed from 8 deg. to 22 deg. The 35-deg. rise of the bus at 800 amp. might not seem particularly objectionable, but if the bus support were to be close to a switch or bus joint, the 57-deg. rise might transmit enough heat to endanger the contact.

For a bus support carrying vertical bars, Fig. 3 (b), the problem is somewhat different if we assume that the casting which mounts on top of the insulator is of malleable iron, as is usually the case. When non-ferrous bolts are employed to break up the magnetic path this casting will effectively short out most of the bolt next to the insulator. In other words, there is not much gain in using non-ferrous bolts, except at the top of the clamp. On this type of support all ferrous clamps and bolts are satisfactory for 600 amp. (36 deg. C. rise). A 1,200-amp., all-ferrous clamp with non-ferrous bolts had a rise of 54 deg. C. Therefore, half-and-half clamps with steel bolts are necessary (34 deg. C. rise). This combination is also satisfactory at 2,000 amp. (41 deg. C. rise), but at 2,800 amp. it is necessary to replace the ferrous bolts by non-ferrous ones (43 deg. C. rise). At higher capacities all non-ferrous parts are required.

It is unfortunate that appreciable savings cannot be made on heavy-capacity bus supports. A clamp such as that in Fig. 3 (c), for a 4-in. square conductor, will attain a rise of approximately 75 deg. C. at 200 amp. when the main part of the clamp is ferrous and the smaller piece non-ferrous. When the materials are reversed the same current produces only an 18 deg. C. rise; at 300 amp. a 24 deg. C. rise. These two rises would be even smaller if it were not for heat conduction from the bus.

Bus Clamps

When a clamp is used to fasten current interchange surfaces together, as in a splice in a busbar, general experience has dictated that a 30 deg. C. rise in the clamp should not be exceeded because of the danger of heating the joint to a high temperature. Therefore, if the clamp shown in Fig. 3a were used as a splicing clamp, half-and-half clamps with steel bolts would be required through 1,200-amp.; up to 2,800-amp. non-ferrous bolts with the same clamp would do. Above this current an all non-ferrous clamp would have to be used.

For cable and copper tubing clamps, when the clamp itself acts as a conductor for a short distance, any substitution is questionable, since the ferrous materials are poor a.c. conductors. Steel can be substituted for non-ferrous bolts up to 1,200 amp. on these clamps, but even here the saving is very small and should be matched against the possibilities of electrolytic corrosion.

Cubicles and Bus Ducts

It is difficult to make definite statements on the substitution of steel for non-ferrous sections in cubicles and bus ducts because of the many configurations, sizes, layouts, heat transfer problems, etc., encountered. In the past ducts and cubicles housing conductors carrying 2,000 or more amperes have generally been made altogether or partly of non-ferrous material, depending on outlines, to avoid inductive heating.

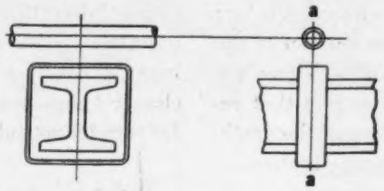


FIG. 5—Copper ring around steel structure member and directly under conductor reduces inductive heating greatly; ring should have one-quarter the current capacity of the conductor

Probably the most important pitfall to avoid is the placing of structural steel members at right angles to the conductors. Side sheets, being comparatively thin, will heat much less than angles or bars used for structural reasons. Formed sections which may be continuous parts of barriers, isolating sheets, etc., can be used to advantage to support transformers, switches, etc., rather than structural sections.

When it is impossible or impractical to avoid steel structural members close and at right angles to a high capacity bus a copper ring around the steel, directly under the conductor, as shown in Fig. 5, will reduce the heating in the steel to a great extent. This ring acts as a short-circuited secondary to the conductor primary and sets up an opposition flux, appreciably reducing the net flux in the steel. Current capacity of the ring should be about 25 percent of the conductor to prevent excessive rises in the ring. Structural sections 4 in., 8 in. and 12 in. from a 400-amp. conductor passing at right angles will show rises of 84 deg., 38 deg. and 21 deg. C. A ring made of 4 x ¼-in. copper section, placed around the steel, reduces rises to 11 deg., 6 deg. and 4 deg. C.

Amortisseur grids and sheets, placed between the steel and the conductor, are also effective methods of reducing rises in the steel.

Ventilation

Ducts and cubicles should be ventilated as well as possible. Members in the top of a closed cubicle will heat to a much greater extent than identically placed members in the bottom, because of increased ambients in the upper air. Expanded steel meshes or gratings are ideal for inclosing equipment, since discontinuous sections heat very little due to inductive causes, and at the same time a well-ventilated inclosure is obtained. Another saving automatically appears as copper buses can be worked to a higher current density when well ventilated.

For ducts, sheets such as transite, bakelite, wood, etc., can be used. These are at the same time non-ferrous, and not copper or aluminum. However, these are all poorer radiators than any of the metals, and ventilation is even more of a necessity.

•

A Better Cement for Bushing Repairs

Usual practice is to use portland cement in a neat mix for cementing together the porcelain skirts of repaired high-voltage bushings. But a better cement is being used in the bushing shop of the Alabama Power Company. It is a product of the Sauereisen Cements Company and was compounded for an entirely different purpose. The new cement sets faster and it does not grow in setting. Although the cement itself is more expensive than portland, it costs less over all because it saves time and labor and does not require any heat or other treatment as it sets.

PRIORITIES PROBLEMS

Recent changes in the series of orders supplementary to order U-1 have relaxed measurably the restrictions on the use of critical materials which were invoked earlier in the war when the materials supply situation was considerably more alarming than it is today. The relaxations embodied in the latest versions of supplementary orders U-1-a, U-1-c, U-1-d and U-1-f probably will not be the last such moves before all material restrictions are scrapped.

In not every case were the recent relaxations ordered solely because the supply of materials concerned is easier. The provision allowing the use of copper for U-1-c extensions, for instance, was dictated largely by the fact that steel wire, which had been required under the last previous version of the order, is not so readily available today. There are other similar examples. However, the fact that restrictions were eased at all is indicative of the vastly improved materials and manufacturing situation.

Some of the relaxations, including many of those in U-1-a, U-1-c, U-1-d and to domestic consumers under U-1-f are obvious. Others are less obvious, such as those in U-1-c permitting utilities to tie to lines built by or for the consumer, a practice not previously allowed. In addition, order L-78, governing the manufacture and purchase of fluorescent lighting fixtures, has been amended to permit the following material uses previously banned:

Non-industrial type fixtures may not be made, in conformity with weight and other restrictions of L-78 without specific WPB authorization. Before December 1, specific authorization was required for manufacture of any but industrial type fixtures. Another L-78 change prohibits the application of any MRO rating lower than AA-2 for the purchase of non-industrial fixtures. Before December 9, MRO ratings of AA-5 or better could be so applied. The change keeps non-essential users out of the market for non-industrial fixtures.

There follows a parallel column briefing of the U-1 relaxations so that the recent modifications may be more easily understood.

U-1-A

February 4 Version	December 10 Version
Army, Navy, Maritime Commission.	Army, Navy, Maritime Commission, War Shipping Administration, Civil Aeronautics Authority.
Two hundred and fifty feet of main extension for service line.	No restriction of length of line.

U-1-C

September 1 Version	December 10 Version
Utilities may make connections to serve farm equipment under other conditions of U-1-c.	Utilities may make extensions, or connect existing extensions, to operate farm equipment under other conditions of U-1-c.
Connections shall not exceed 100 ft. per animal unit.	Extensions, including any part built by or for the consumer, shall not exceed 100 ft. per animal unit.
Primary lines shall be single-phase and made of No. 6 galvanized steel wire, copper-covered steel wire or composite conductor, consisting of one or more strands of aluminum or copper with one or more strands of bare, galvanized or copper-coated steel, having conductivity equal to or less than that of No. 4 copper when available in excess inventory of another utility; or any conductor whose conductivity is equal to or less than that of No. 6 copper which conductor is salvaged from plant after March 24, 1943.	Primaries may be any type or size of conductor whose conductivity is equal to or less than that of No. 6 AWG copper, or any type or size conductor obtainable from a utility's excess inventory.
Secondaries and service drops may not contain more than 30 lb. of non-ferrous metal where a service transformer must be installed, nor more than 55 lb. of non-ferrous metal where no transformer need be installed.	Secondaries and service drops under same provision as for primary lines.
Certification from U. S. Dept. of Agriculture County War Board.	County agricultural observation committee certification.
Connection costs are less than $1,500 below ground or $500 above ground.	Total material cost, exclusive of any part built by or for the consumer, is less than $1,500 below ground or $500 above ground.
	Six milk goats, 30 other goats or 160 kids marketed per year equals one animal unit.

U-1-D

March 29 Version	December 10 Version
Material cost for industrial or commercial consumer is less than $1,500 underground, $500 above ground; facilities, including service drop, can be built with not more than 60 lb. of copper in conductor and the utility has so certified with a copy of the builder's application for L-41 approval.	Extension for industrial or commercial consumer is designed to use smallest sizes and quantity of equipment to furnish service at minimum standards. No other restrictions on allowable amount of materials.
In domestic extensions material cost is less than $1,500 underground or $500 above ground; and facilities can be built within limits of the housing utilities standards.	Domestic extensions can be built within limits of the housing utilities standards and in the case of electric facilities primarily to serve cooking appliances, the dwelling has no range, and complete facilities to a cooking range location are not installed for serving either a gas or electric range the consumer used in an earlier dwelling may be made even though facilities for serving another type of range are already installed.
	For all consumers total materials cost exclusive of any part built by or for the consumer does not exceed $1,500 underground or $500 above ground; no other utility can render the same service with less critical material; the extension does not duplicate an adequate existing service or constitute a standby; and the producer has completed form WPB-3348.
Utility facilities can be built within the limits of the utilities construction standards under schedule B.	Extensions can be built within limits of the utilities construction standards, under schedule I, including any part built by or for the consumer.
Cost of utilities facilities, including any part built by or for the consumer does not exceed $1,500 underground or $500 above ground.	Total material cost for each extension, exclusive of any part built by or for the consumer, does not exceed $1,500 underground and $500 above ground.

U-1-F

September 30 Version	December 10 Version
In the case of electric facilities to serve domestic consumers, the dwelling to be served is in a locality listed in schedule A of this order.	No geographical restrictions on domestic extensions.
	Same provisions for facilities to serve cooking facilities as in December 10 version of U-1-d above.
For industrial and commercial extensions, the consumer is engaged in the manufacture of a product or in the conduct of a business or activity listed in schedules I or II of CMP regulation 5, as amended, or is a school, church or hospital.	For industrial and commercial extensions, the consumer is engaged in the manufacture of a product or in the conduct of a business or activity listed in schedules I or II of CMP regulation 5 as amended; is an electric, water, gas, steam-heat, telephone or telegraph utility; is engaged in the petroleum industry except in retail marketing; is engaged in the business of mining, or of burning refractories; is engaged in the business of radio communication or broadcasting; or is a school, church or hospital.

UTILITIES CONSTRUCTION STANDARDS (U-1-F)

September 30 Version	December 10 Version
For primaries, steel, or any other type of conductor not entirely copper which is available in excess inventory whose conductivity is equal to or less than that of No. 6 AWG copper.	For domestic primaries, any type or size conductor whose conductivity is equal to or less than that of No. 6 AWG copper, or any type or size conductor obtainable from excess inventory.
For secondaries, no limitation except for domestic extensions, which may be any type of conductor having a conductivity equal to or less than that of No. 6 AWG copper.	Secondaries and service drops for domestic extensions same as primaries above. No limitation on primaries, secondaries or drops for commercial or industrial consumers except in quantity as shown below (in copy of order).
Domestic primaries, up to 900 conductor-feet of types permitted above.	Domestic primaries, not to exceed 1,000 conductor feet, including primary, secondary and service drop.
Domestic secondaries and service drops, 20 lb. of nonferrous metal in conductor, less one pound for each 90 conductor-feet or fraction thereof used in primary, except that 45 lb. of copper may be used if service can be made from a transformer already installed and in service.	Domestic secondaries and service drops same as domestic primaries above.
Industrial consumers, smallest size or quantity of equipment or conductor to furnish service at minimum standards.	Same as September 30 version.
For commercial primaries, up to 900 conductor-feet of any allowable conductor as defined above.	For commercial primaries, the smallest sizes and quantities of equipment and conductor required to furnish service at minimum standards.
For commercial secondaries and service drops, 40 lb. of nonferrous metal, less one pound of non-ferrous metal for each 90 conductor-feet or fraction thereof of conductor used in primary, except that 65 lb. of copper in conductor may be used where no additional transformer is needed.	Commercial secondaries and service drops same as primaries above.

Editorials

S. B. WILLIAMS, *Editor*

Regulation Would Help Cure REA Troubles

REA is being investigated by the Senate agriculture committee. The hearings which started last week have already unearthed some very smelly information and rumor has it there is plenty more to follow.

It is unfortunate that a movement designed to bring electric service to farmers who otherwise would not be served and at a low cost should also be plagued with graft. However, as former administrator John Carmody said, "It's hard to keep the leeches from the feedbox when there is plenty of money available."

REA is a splendid thing for this country, provided it remains within the confines set up in the original act. When it operates solely to extend service to the unserved farmers, and in that capacity acts only as any wise lender would act, it contributes to American economy. The moment it begins to exercise any authority over selection of equipment or over operating practices it opens up opportunities such as those disclosed in last week's testimony. And therein lies one of the principal reasons for state utility commission regulation of rural electric co-ops. If the co-ops had such regulation they would not be entirely dependent on a federal spending agency.

On more than one occasion REA has persuaded, if the word is strong enough, co-ops to buy new and untried devices whose only merit was their low price. The experiences to date with some low-wattage transformers and meters is something that would never exist with private power companies, because they would have found out first from field trial whether or not the devices would work. Under commission regulation these departures from accepted practice would not have been permitted on such a large scale.

REA has had men of ability as administrators. Unfortunately they have not always been allowed to do the job their own way because of political interference. Take this interference away, take REA out of politics, remove interference from outsiders who would grow fat financially and politically from pooling REA resources and put co-ops under state regulation, and REA will be able to do the job it was set up to do and which only a federally financed agency such as REA can afford to do.

A Splendid Record Marred

FOR the first time since Pearl Harbor war material production has been lost because electricity was not available due to a strike of power company labor. The loss wasn't great because other employees jumped in and got enough power on the line to prevent any further loss of anthracite coal and war production. It is too bad that such a splendid record should be marred by the willfulness of a few.

This strike, which occurred in the Pine Grove and Hauto plants of Pennsylvania Power & Light, was of short duration. Pine Grove, with 65,000 kw., remained on the lines because more than half of the employees stayed in; Hauto, with 115,000 kw., went out. Fortunately this happened on a Saturday morning, so that the effect was not great. By Monday enough labor had been recruited from supervisory employees to keep 35,000 kw. on the line.

An independent union representing 3,100 out of 3,800 eligible employees had previously been certified as the bargaining agent. The Utility Workers Organizing Committee, CIO, claimed, but apparently without foundation, to represent practically all the employees of these two power plants. In order, seemingly, to harass both the company and the independent union, UWOC used a disciplinary action by the independent union against one of the CIO members as a reason for calling the strike.

Last week the trouble was brought to the attention of the War Labor Board and it ordered the men back to work, promising a consideration by WLB of the disciplinary action in spite of the fact that it was taken by the recognized union.

This is another of those disputes for jurisdiction with the company in the clear. It has occurred before during this war in manufacturing plants, but we had believed that it could not happen with utility employees, to whom continuity of service is something almost sacred.

A further unfortunate part of this whole thing is the wishy-washy attitude on the part of the WLB. By kowtowing to the big union it may be laying the seeds for a much more serious labor disturbance in these plants.

Wind-Power Prospects

RESULTS already obtained from the Smith-Putnam wind-turbine experiment at Grandpa's Knob in Vermont seem to indicate that the project is electrically successful and that mechanical and structural problems are by no means insuperable. Whether power can be derived economically from the wind is still nearly as much of a question as it was in Don Quixote's day of jousting with similar monsters. However, we in the United States apparently are not alone in cherishing hope; the Russians are reported to have several installations a fifth as large as our 1,000-kw. trial and are rumored to have one several times as large.

Much of the groundwork for a broadened program,

when the economy has been substantiated, has been laid in connection with the Vermont project. Anemometer techniques have been elaborated, wind tunnel studies made, terrain-exploration organized, erection procedures perfected, controls improved, mechanical-structural pitfalls ferreted out and gust phenomena studied in relation to fluctuating electrical frequency and mechanical torque.

Availability of all these data from the elaborately executed New England venture nevertheless will still leave much exploration and study for any area where wind conditions appear favorable enough to warrant emulation of the project on more commercial terms. Local typography, forestation, risk of ice and gales will have to be studied for numerous locations over any promising area before one can be selected. The best sites may prove inaccessible by road, railroads may be too remote for delivery of the heavy parts, too much clearing of timber may be required. Balloon courses may again have to be followed by theodolite. Wind must subside enough at times to facilitate erection and assembly of close-tolerance parts of much bulk and weight at great structural heights. It may also be that an induction generator is the answer. The present study deliberately chose the tougher synchronous alternative.

Then only can one decide how much the present cost of some $500 per kilowatt of developmental outlay can be trimmed so that wind can team up profitably here and there with stored water to provide a firm capacity union. Meanwhile the courage and persistence and thoroughness of the Grandpa's Knob sponsors give assurance that the potentiality of electric generation by wind power will either be confirmed or abandoned. Right now it is far from abandonment.

Substation Foundation Design

SINKING TERRAIN over coal mining territory is not the only place where foundations are likely to settle, nor is freshly filled ground. Reports are heard of gradually subsiding bases in spots where the original surface is intact but underlying strata are insufficiently firm to carry the loads imposed by heavy electrical equipments.

Enough instances of the nature are reported to give warning that more attention can well be given to deeper borings and provision in design for settlements that cannot fully be prevented. Electrical men are prone in their thinking to put emphasis on the electrical stability of a substation design first and give secondary consideration to wind and ice loads, floods and unbalanced conductor stresses. Foundations apparently take third place in the computation of mechanical loads and stresses.

Third place is not too far down the list just so long as it means that ample thought is given to that stage in the design. If deeper borings and more thorough introduction of experience data from structural compendiums point to too costly a foundation, then the next alternative is to accept the eventuality and provide for subsidence. That means three things. One is to design the layout with enough "give" to permit sagging of one section or of one corner. A second is to make frequent checks to discover settling by comparison with fixed bench marks. The third is to arrange for correctives that can be applied before conditions get out of hand.

Index Available

Because of paper shortage, ELECTRICAL WORLD'S semi-annual index, which ordinarily would be included in this issue, is printed separately and may be obtained by subscribers without charge on request. Address Editor, ELECTRICAL WORLD, 330 West 42d Street, New York 18, New York.

Research Prevents Frozen Design

ONE OF THE wire and cable manufacturers has recently opened a new laboratory building for testing everything that goes into insulated conductors as well as the finished product. This building, which occupies several floors and covers a sizable ground area, is equipped with all the modern tools for physical and chemical tests and is manned by a large staff of trained technicians.

In addition to the materiels control that is exercised in this laboratory there is constant experimentation leading to improvement in process and product, and the thought struck us as we watched the different operations that the electrical industry need have no fear of frozen design resulting from standardization.

Aside from the fact that this is a new laboratory and perhaps larger than the laboratories of most cable manufacturers, it is not something novel in electrical manufacturing. The amount of product improvement research that the electrical equipment producers carry on regularly is enormous. Wire and cable as a product is perhaps as highly standardized as any electrical product, yet hundreds of trained technicians are daily searching in laboratories for ways to make it better—to last longer and generally do a better job.

Nothing is more competitive than insulated wire and cable, and because of this the margin between selling price and cost has to be small. Nevertheless, it must pay manufacturers to do all of this control and research work and the answer must be that the more standardized a product is and the more competitive the greater the necessity for making a better product or for finding improvements. Under such circumstances standardization cannot result in frozen design or performance.

Washington Comment

By R. N. LARKIN, Washington Correspondent

The Jones-Onslow Deal

ONE OF THE ITEMS on the agenda of the Shipstead committee investigating the Rural Electrification Administration which will be overshadowed by more sensational disclosures of intrigue and maneuverings for power is the story of the Jones-Onslow Electric Membership Corporation of Jacksonville, N. C.

Jones-Onslow is an REA co-operative in whose territory the Navy built the New River marine training base and the Cherry Point marine aviation base. Jones-Onslow competed with the Tidewater Power Company for the contract to serve the two bases—and won. Today, with the Navy pressing negotiations to take over the system Jones-Onslow built with REA funds, the co-op has some lines it didn't have before the war and whatever memories coming from having had a fast ride with another man's bankroll.

$523.50 per Kw.

In a letter to Rear Admiral Ben Moreell, Chief of the Bureau of Yards and Docks, the co-op, on November 4, offered to sell its war-born system to the Navy for $3,736,334.69, plus a few extras which will total less than $20,000. The system was then incomplete, with a final 2,000-kw., diesel-powered generator under installation. This the Navy will have to pay for. Complete, the system is to cost $4,345,110.46, according to Jones-Onslow.

The Navy gets a 110-kv. inter-base transmission line, 100-odd miles of distribution system and two generating stations totaling 8,300 kw. when completed the end of this month.

The system's per-kilowatt cost comes out to $523.50 using Jones-Onslow figures. Many engineers will insist that $523.50 per kilowatt is from two to two and one-half times what a good, pre-war system should cost at the outside.

Certain government men make it sound even worse. They argue that while one of two 1,300-kw. diesel units is technically on the line, it has never begun to turn out that amount of power, that it is in fact totally unavailable for carrying a load. They rate the system at 7,000 kw., which comes out to $620.73 per kilowatt. But WPB says the capacity is 8,300 kw., and the cost must thus rest at $523.50 per kilowatt.

Of interest to the Shipstead committee might be the reason why Jones-Onslow would pay a fancy price for two 1,300-kw. diesel-powered generators—located about 3,000 miles away from when they were needed—which had not been operated for thirteen years and whose log books showed that they never had operated properly. Without examination on the scene to determine whether they were in running order, government men insist, the units were purchased and moved from Tonopah, Nev., to Jacksonville, N. C. Their cost, installed, was something over $300,000. The Navy hopes ultimately to get the other unit on the line.

Tidewater Competitive

Of even more interest to the Shipstead committee should be the question of why the Navy, which could have had its bases served much more promptly for the expenditure of $300,000 on transmission lines for Tidewated, chose to set Jones-Onslow, a distribution co-op, up in the power business. This the Navy did when it gave its contracts to Jones-Onslow rather than to Tidewater. Tidewater quoted an average rate of 1.45 cents per kilowatt-hour, while Jones-Onslow quoted 1.02 cents.

"On the basis that the co-operative offer would provide a primary source of power in the area and that the co-operative rate would be 0.43 cent per kilowatt-hour less expensive than the Tidewater proposal," wrote Admiral Moreell to Navy Secretary Knox last August 10, "the Navy accepted the co-operative's offer and entered into a contract with the co-operative on July 5, 1941."

The Navy declines extensive comment while the matter remains under negotiation. It is by no means committed to paying the Jones-Onslow asking price. Certainly with today's knowledge, it would have been cheaper had the Navy gone along with Tidewater originally. Certainly, if Tidewater's rate were excessive, the Navy would have had ample authority to renegotiate its excessive profit, and the legal duty to do so. Thus the Navy's plea of savings per kilowatt-hour in choosing Jones-Onslow fails of persuasion.

Short Term Rate

Actually, the 1.02 cent average rate of Jones-Onslow lasted for just 360 days. When that contract ran out on June 30, 1942, the aforementioned complications precluded immediate agreement on a new contract. The second contract proposal which Jones-Onslow ultimately offered the Navy included an average rate of about 2 cents, with an increase to about 5 cents per kilowatt-hour when the war ended. The Navy apparently figured that if it were going to pay for the system in its rates it might as well own it, and opened negotiations toward taking over the system lock, stock and barrel.

Meanwhile, Jones-Onslow has been serving the bases under the agreement that the Navy will pay its cost of service, as determined by the Federal Power Commission. Under this arrangement, REA reported to the Comptroller-General on December 2 the Navy received 24,118,031 kw.-hr. during the fiscal year of 1943, at cost to Jones-Onslow of $321,697.10. This figures out to a cost of 1.33 cents kilowatt-hour, only 0.12 cent below the original rate quoted by Tidewater.

Perhaps the Navy would not have picked Jones-Onslow originally had its first choice been between rates of 1.45 cents and 1.33 cents per kilowatt-hour, or had it any reason to believe that Jones-Onslow's 1.02 cent rate might have been a short-term "loss-leader" calculated for competitive purposes only.

This is by no means the whole story of Jones-Onslow, but it may be sufficient to give the Shipstead committee a busy morning.

NEWS OF THE WEEK

Conspiracy Alleged in REA Investigation

Senate agriculture committee investigating REA put on record detailed picture of alleged bid-rigging and conspiracy among REA officials — Craig named as alleged ringleader

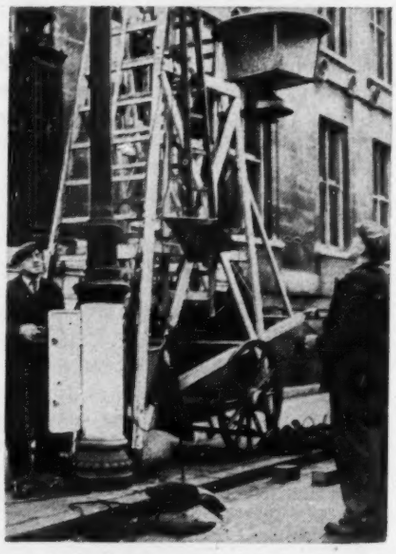
The Senate agriculture committee investigating the Rural Electrification Administration spread on its records last week a detailed picture of alleged bid-rigging and conspiracy among REA officials to force the use of copper wire exclusively on co-ops which often chose aluminum or other composite conductor.

Copper Companies Involved

Ringleader of the move within REA was Former Deputy Administrator Robert B. Craig, who became assistant to the president of the Copperweld Steel Co. last spring after his resignation. Names of such copper companies as Anaconda, Kennicott, Phelps-Dodge and the General Cable Co. were included in membership of the Copper Wire Engineering Association, which worked with Craig's REA coterie in promoting use of copper and copperweld conductor to the exclusion of aluminum and amerductor, testimony showed.

Committee members, after hearing an Agriculture Department report which demonstrated these practices, expressed surprise that Craig had been retained as Deputy REA Administrator for 14 months after the report was filed. Their questioning then brought out that two of his associates in the scheme still are employed by REA. Another is special assistant to the director of the power division of the Office of War Utilities and supervises the handling of all REA applications sent to OWU.

Ward B. Freeman, formerly co-ordinator of engineering for REA and now associated with former REA Administrator John Carmody in the Maritime Commission, testified at length to the activities of REA's "copper clique." He charged that a report prepared for REA by a North Carolina University engineering professor showing that aluminum conductor stood up better than copper and cost less to maintain was pigeonholed by one of the group, and added that information leaks to the CWEA were steady.



"STAR" LIGHTING—In certain London areas a form of blackout modification, which is an extension of "star" lighting, has now been allowed. Here are some of the St. Pancras Borough Council preparing street lights in their area which will have the new lighting

Freeman told the committee that he, Craig and Carmody had once discussed appointment of an REA regional engineer and that after the meeting adjourned Carmody instructed him not to notify the man selected pending disposition of an administrative matter. The next day, Freeman said, the prospective appointee received a telegram of congratulation from CWEA.

Copper Used Principally

While Clarence Winder, now special assistant to the director of OWU's power division, was chief engineer of the Michigan commission, after having been with REA, Freeman testified, 5,000 miles of REA lines were built in the state, and only one job used conductor other than copper. Winder, Freeman said, was one of Craig's pro-copper group.

It was Michigan experience which forced Carmody to discontinue asking bids on REA work, Freeman went on. One utility had stated publicly that not one mile of REA line would be built in the state, and when bids were asked, immediately built lines which prevented REA from entering proposed territory. Carmody then substituted the system of picking contractors without asking publicly for bids, Freeman said, which policy Craig later amended to one of "conductor pre-selection."

Under the "pre-selection" policy, Freeman testified, bids were so manipulated that co-ops which had chosen aluminum conductor wound up with copper or copperweld lines, frequently at added cost. He explained that where co-ops chose aluminum or other composite conductor, "because it was invariably low," system specifications would be changed to put copper in a more favorable competitive position and pressure would be exerted on co-op

members to specify copper or to hire CWEA engineering help. When copper was specified and bids were let, change orders would be instituted by REA fiat, and as often as not the co-op would wind up with a copper line of the same capacity which had lost out in original bidding, Freeman said.

Earlier in the hearing committee counsel Carroll L. Beedy introduced a memorandum from Assistant Agriculture Secretary Paul Appleby which contained standards for REA lines that later were formalized and made mandatory. The memorandum, he said, disclosed REA's theory that even though copper cost more for initial installation, its upkeep cost was lower than that of aluminum and other composite conductors. This theory has been demonstrated to be false, Beedy said.

Initial Cost Not Important

Beedy then charged REA with a philosophy that the initial cost of a project was unimportant so long as it gave reasonable promise of being capable of paying for itself. No attempt was made, he insisted, to reduce the initial cost of projects by using aluminum or similar lines even though a project be judged economic with more expensive copper.

Beedy's charges followed a statement by Carmody that REA had been a pioneer on development of low-cost lines, meters and billing practices because it did not operate on the private company theory that a 6 percent return was guaranteed throughout good years and bad by the rates established by state regulatory commissions. When confronted with the Appleby memorandum, Carmody declined comment on the basis that it was dated after he resigned as REA administrator, saying only that he "didn't understand it."

Freeman testified later that "the copper people" had suggested that a differential be applied to their product to enable it to compete with lower-cost conductors. Justification for such a differential, they argued, could be found in copper's lower maintenance costs. Freeman said he had attempted, doubting this theory, to obtain comparative figures on line maintenance costs from private companies, but was unable to get them. In the fall of 1938, he went on, the Van Lear report on this matter, based on REA's experience with its own lines, demonstrated the theory to be false. The report was pigeonholed, he said, by M. M. Samuels, then head of REA's research organization.

Freeman testified to a memorandum he sent Harry Slattery, REA Administrator, at the latter's request. Its points included:

1. A "successful and concerted effort" was made in REA to have conductor manufactured by the CWEA used, even though it cost $10 to $75 more per mile.

2. CWEA got "confidential and advance" information from REA employees.

3. When employees of his engineering division complained on the rejection of their advice, they were dropped or transferred, resulting in a low morale in the division.

4. Project engineers and contractors, seeing sound engineering judgment discarded, "got on the gravy train" and operated on the theory that high-cost projects were perfectly acceptable.

Van Lear Report

The Van Lear report, compiled from REA project histories, he said, showed the incidence of conductor trouble per thousand line-miles to be 1.8 for aluminum, 2.1 for copperweld and 4.3 for copper. Trouble cost per 1,000 line-miles averaged $52.60 for aluminum, $138.80 for copper and $180.70 for copperweld.

Another report covering 350 co-ops and 150,000 pole-miles of line, Freeman testified, showed breaks-per-100 miles to be 0.62 with aluminum, 1.1 with copperweld and 1.3 with aluminum. Even after these reports were submitted, he went on, bids calling for aluminum were thrown out by REA on the basis that copper had a lower maintenance cost.

A project known as "Missouri-42-Caldwell," Freeman said, cost the co-op $6,000 in excess of the bid it had originally accepted after an employee still with REA, wrote the co-op, which had chosen aluminum conductor because it was low by $4,000. A month after a bid was accepted in June, 1939, Freeman testified, the employee, an engineer named O'Shaughnessy wrote the co-op that the bid had been rejected and that a design review had indicated that a much more economical project could be built. He wrote that the line should be of copper and that the co-op board should pass a resolution specifying that material, suggesting also that the board hire CWEA help. Later, a bid for a line of small copper was accepted. Then a change order specifying approximately the original size of copper conductor which had first been bid unsuccessfully was put through on the project by REA, increasing the project cost by $6,000.

"It was a way of beating the bid," Freeman asserted.

The Agriculture Department report on the situation commented that "obviously no saving was made (by O'Shaughnessy's redesign) and it is further obvious that O'Shaughnessy changed the design to insure the use of copperweld."

NEWS BRIEFS

BRUCE STEVENSON, Ohio farmer and customer of the Ohio Midland Light & Power Co., which serves his community, was awarded the REA plaque "for distinguished war service in the production of the nation's food through the use of rural electric power" at a ceremony held last week at Lancaster, Ohio. To accomplish such results, the Stevensons are now using twice as much electric power as they did before Pearl Harbor. Using 1,000 kw. a month, the family has a feed grinder, feed mixer, milking machine, milk cooler, electric brooder, fans and lights in the chicken house and an electric water pumping system, all installed since the war started.

ROVING POWER TRAINS that will follow the United Nations armies into cities reconquered from the Axis and restore electric service overnight are being built by the Westinghouse Electric & Manufacturing Co. Each train will be a self-contained electric generating plant with all the machinery of a regular power house and requiring only coal and a small amount of water for its operation.

FOUR SINGING STREET CAR OPERATORS have gone on the air recently in Atlanta. Billed as "The Four Oscars," the program is sponsored by the Georgia Power Co.

AN ASSOCIATED PRESS DISPATCH tells of a man out in Omaha doing the family wash—his wife was just home from the hospital—when a meter reader, a lady meter reader, walked into the basement. "She looked at me, up to the elbows in suds," he said, "then she shook her head and walked out."

LAST MARCH, IN DELAND, FLA., JAMES C. WEST, lineman in the Orlando crew of the Florida Public Service Co., noticed a burning house on his way to work; stopped to investigate. Led by screams from a bedroom, West crawled on hands and knees through the smoke and rescued Kenneth Sharp, age 1, from a flame-enveloped bed. Last week hero West modestly accepted a bronze medal and $500 from the Carnegie Hero Fund Commission.

BECAUSE W. V. GUY and E. D. SCOTT, industrial engineers of Birmingham Electric Co., developed and installed new lighting equipment in war industries that enabled war workers to increase their productive capacities, they were recently awarded the national gold bomber lapel pin and presented with certificates of merit.

P. P. & L. Labor Union Awaits NWLB Decision

Employees' Independent Association of Pennsylvania Power & Light Co. waits for NWLB decision in Myles Frantz case — Disciplinary action toward Frantz precipitated recent strike at Pine Grove and Hauto plants

The Employees' Independent Association of the Pennsylvania Power & Light Co., the validity of whose contract covering 3,100 P. P. & L. workers was threatened by the National War Labor Board, this week awaited a board decision on the case of Myles Frantz, boiler room operator at the P. P. & L. Pine Grove plant, whose disciplining by the company last August precipitated last week's strike at the Pine Grove and Hauto plants.

NWLB Took Jurisdiction

The board took jurisdiction over the case last week after striking members of the Utility Workers Organizing Committee (CIO) returned to work, but only over the protest of the EIA, which, as recognized bargaining agent, worked out with the company last September a plan for Frantz's return to work with a demotion of one grade. Frantz, member of UWOC'S Pine Grove Local, refused the settlement and appealed to UWOC, which precipitated the strike.

General EIA Chairman John Thomas told ELECTRICAL WORLD at last week's hearing before NWLB that EIA "intends to see that the settlement it negotiated with P. P. & L. in the Frantz case is carried out." It was not known whether EIA would resort to a strike to uphold the validity of its contract as exclusive bargaining agent for all eligible P. P. & L. employees, but EIA officials were angry over NWLB's act in taking jurisdiction, since adequate machinery for such grievances exists in the EIA-P. P. & L. contract. NWLB took jurisdiction under a decision overruling its policy and precedent, and attempts by an industry member to warn all unions that the Frantz case did not set a precedent for similar future cases led to an uproar in the hearing room, in which CIO officials burst into time reserved solely for board members to launch bitter attacks on industry member Almon Roth. WLB Vice-Chairman Frank Graham, representing the public, adjourned the meeting in an uproar.

P. P. & L. supervisory employees operated the struck Hauto plant for four days to keep war production losses at a minimum. Less than half of the normal crew at the 65,000-kw. Pine Grove plant went on strike, and the 90 who remained in the plant kept output at capacity through the five-day strike. When all Hauto workers struck, leaving only a small maintenance crew, which straggled away unreplaced during the night, the company recruited 28 supervisory employees who kept two of six turbines and two frequency changers in operation. A dozen anthracite collieries, employing 7,000 men, lost a day's work when insufficient power was available, and the Bethlehem Steel Co., 45 miles away, was forced to pull some electric furnace load, losing 300 tons production, but normal week-end slackening of war loads and the recruitment of the supervisory employees enabled the Hauto plant to provide enough service to meet industrial commitments by December 13. During this four-day period a 15,000-kw., 25-cycle unit and a 20,000-kw., 60-cycle machine were kept running at a total output for both of between 15,000 and 20,000 kw. The neighboring anthracite collieries and the Bethlehem Steel Co. are on 25-cycle systems.

WLB came in for criticism from all parties concerned over its confused handling of the case. It held a hearing November 30 to determine whether the machinery in the EIA-P. P. & L. contract was sufficient to cover the Frantz case. Before it notified EIA or P. P. & L. of any decision, it held another hearing December 13 in which the UWOC was ordered to appear and explain a warning by UWOC General Chairman Harold J. Straub that locals in Springdale, Pittsburgh, Scranton and Altoona were considering sympathy walkouts. That hearing was followed with an ultimatum to return to work on pain of Presidential action. The ultimatum carried the promise that if the strikers returned to work by December 15 the Frantz case would be "heard on its merits" December 16. This was the first intimation to EIA or P. P. & L. of a decision on the topic discussed at the November 30 hearing, namely, whether the existing bargaining machinery was sufficient. A decision unfavorable to EIA was mentioned by member Wayne Morse in a telegram to Straub December 11, but EIA and P. P. & L. were not notified.

Attorney Protests

At the December 16 hearing attorney for EIA protested vigorously that WLB had not notified any of the parties to the November 30 hearing of its decision, but had intimated a decision adverse to EIA in its December 13 ultimatum. He insisted that UWOC had no right to appear before the board in the Frantz case since it held no contract and, under the National Labor Relations Act, could not represent any P. P. & L. employees as bargaining agent as EIA was their certified, recognized and contract-holding bargaining agent.

METER COMMITTEE MEETING—Group picture of the meter committee of the Philadelphia Electric Association, which met in Philadelphia last week to discuss meter obsolescnce, test schedules and recent imminent developments in the art

Final Unit Installed At Bonneville Dam

Tenth generator set as ceremony marks completion of $81,000,000 project — Begun ten years ago — Oregon and Washington dignitaries with army officers participate in affair

Army engineers threw a switch last week putting into operation the tenth and final generator to be installed at the Bonneville Dam project, begun ten years ago.

Participating in the ceremonies, signifying completion of the $81,000,000 dam, were Gov. Earl Snell of Oregon, Gov. Arthur B. Langlie of Washington, Lieut.-Col. Ralph A. Tudor, army district engineer, and Dr. Paul J. Raver, Bonneville power administrator.

Vast Electrical Energy

Engineers stated that 74,000 additional horsepower was harnessed by the new generator and that the dam's power capacity was boosted to 516,400 kw. Now the full load of the Bonneville Dam is available to the Pacific Northwest's power grid, carrying electric energy generated at Grand Coulee Dam and by numerous private power utilities.

The original plans, which army engineers developed more than a decade ago, called for construction of ten dams on the Columbia River, which rises in the Rocky mountains of Canada and drains an area of 259,000 square miles as it flows 1,210 miles to the Pacific. Bonneville was selected for the first dam down-river because it is at the head of tidewater, 140 miles from the ocean, and because Bradford Island thrusts through the current at that point to divide the river and make an ideal dam-site.

Among the ten projected dams were Grand Coulee, constructed by the Bureau of Reclamation of the Department of Interior, and Rock Island Dam, near Wenachee, completed in 1933 by Puget Sound Power & Light Co. Today Bonneville already outstrips in power production Grand Coulee Dam, which is only partially completed.

The Bonneville-Grand Coulee network of transmission lines and substations, lying principally within the state of Washington, but reaching as far south as Eugene in Oregon, includes 2,524 miles of line. This figure breaks down into 1,056 miles of 230,000-volt lines, 1,102 miles of 115,000-volt lines and 366 miles of lower voltage lines. Total substation transformer capacity is approximately 2,500,000 kva.

It was not until 1935, when Congress passed the rivers and harbors act, that Bonneville received official approval. Since then, however, appropriations have come regularly. The total cost of $81,386,000 expended for the project was divided as follows: $39,431,477 for the power plant; $5,412,937 for the highest single-lift lock and navigation facilities; $36,541,584 for the spillway dam, fishways, and miscellaneous construction items.

The first three generators installed at Bonneville had a capacity of 42,200 kw. each, and the next seven a capacity of 54,000 kw. each. Each required about a year to manufacture in General Electric's plant at Schenectady and five or six months were needed to install and test each generator after its arrival.

BONNEVILLE UNIT COMPLETED—Shown here is the tenth and final generator unit of the Bonneville project about to be activated in the extreme far end of the power house. The capacity of the new unit is 54,000 kw., bringing the dam's total power capacity to 516,400 kw.

Oregon Utility Sues to Avoid Rate Order

When the Portland General Electric Co., along with Thomas W. Dalzell and R. L. Clark, independent trustees of the Portland General Electric Co., filed suit last week in the Circuit Court at Salem to invalidate an emergency order issued by state Utility Commissioner George H. Flagg, directing the company to put into effect a contemplated rate reduction at once, events in the situation have been moving rapidly.

On December 13 Federal District Judge James Alger Fee lifted his temporary injunction preventing the Portland company from putting into effect a rate reduction which was to amount to $700,000 or $800,000 annually. While the trustees are not in favor of rate reductions at this time, from the standpoint of the stockholders, the company itself is generally favorable, wherever reductions can be made, as the part of good business policy.

A plan for rate reduction had been worked out by the company that was deemed practicable, but which carried with it certain concessions to the company; namely, providing the company at the same time with a war emergency fund and an employee pension program. This had all been worked out in detail with state utility commissioner George H. Flagg. This is the plan that was held up by the injunction.

Immediately after Judge Fee lifted the injunction Flagg came out with what was termed an emergency order directing the company to put the contemplated rate reduction into effect at once, but leaving out any mention of the concessions which had been agreed upon by virtue of which the company would be justified in making the cut.

This brought sharp admonitions from

Judge Fee concerning what he termed Commissioner Flagg's "collaboration" with the P.G.E., his action in seeking to reduce rates, and the company's relations with the Bonneville Administration. Examination of the court's records brought Judge Fee's attitude to light as a cross petition to block Flagg's emergency order seemed headed for the Circuit Court of Marion County.

The change in jurisdiction was recommended by Judge Fee on December 15, at which time he assailed the commission, company and Bonneville activities in a dissertation that concluded with his refusal to issue a restraining order to halt the efficacy of the Flagg directive. "It is fairly obvious (Flagg's speedy signing of the emergency order) that this is a political gesture on the part of the public utilities commissioner," he commented. "He did not give the matter the consideration the court expected. He did not accept the responsibility the court placed upon him."

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Customers to Share Earnings Excess

More than 8,000 domestic and commercial customers of the Torrington Electric Light Co. will share in the distribution of about $60,000 in excess 1943 earnings by direction of the Connecticut Public Utilities Commission.

Customer dividend checks will be mailed by the company and no question of excessive rates is involved. The board held that this method of sharing revenue met the war situation more justly than a straight rate cut. A similar customer dividend was announced last week by the Derby Gas & Electric Co., totaling $60,000 for December and rebating $15,000 a month for the first half of 1944.

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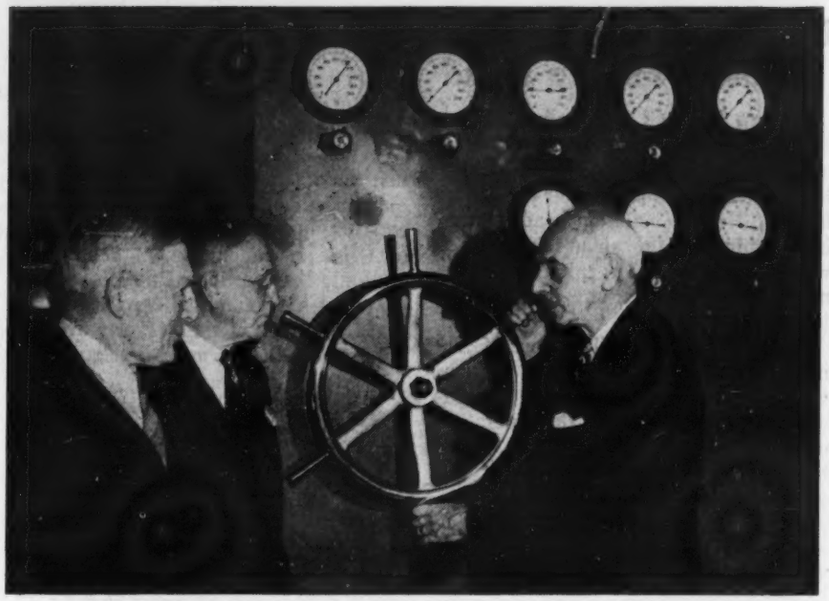
Copper Released for Electric Equipment

WPB has further relaxed its restrictions on the use of copper in electrical equipment by allowing the use of copper and copper-base alloy in renewable electric fuses and electrical wiring devices. Steel had been prescribed for these products under Orders L-161 and L-277, which were amended last week.

Production of steel fuses has been curtailed by the additional screw machine time required to work steel and the difficulty in obtaining steel rod. Corrosion of steel wiring devices after short use dictated the other change, but restrictions on copper use in non-renewable fuses were retained.



START NEW FISK TURBINE—Charles Y. Freeman, chairman of Commonwealth Edison Co., starts operation of new 147,000-kw. turbo-generator placed in service December 20 at the company's Fisk station, Chicago. Looking on are Edward J. Doyle (center), president, and Harry B. Gear, vice-president. The machine is the largest steam-generating unit to be built in this country since Pearl Harbor

New Turbo-generator Now in Service

At Fisk station in Chicago this week Commonwealth Edison Co. placed its giant new 147,000-kw. turbo-generator in service after more than two years of planning and construction. The machine is the largest steam-generating unit to be built in this country since the beginning of the war and will be used to meet the growing power demands of the hundreds of war production plants in the Chicago area.

The new Fisk generator feeds energy into the power pool embracing the territories served by Commonwealth Edison Co., Public Service Co. of Northern Illinois, Western United Gas & Electric Co. and Illinois Northern Utilities Co. At full capacity it is large enough to have carried Commonwealth Edison's entire peak load of 35 years ago.

In an informal ceremony on Monday Mr. Freeman turned the steam throttle valve which started the turbine operation. Also participating were Edward J. Doyle, president of the utility; Harry B. Gear, vice-president in charge of operating and engineering, and A. G. deClercq, vice-president in charge of service and construction.

"We are pleased and proud to add this unit to our system because we know the kilowatt-hours it generates will help hasten victory," Mr. Freeman said. "Forty percent of our total electrical output is now going into the production of planes, ships, tanks and other materiel of war.

"The new machine represents an increase of 140,000 kw. in the capacity of the Commonwealth Edison group of companies, 7,000 kw. being required for station auxiliary use. This brings our aggregate system net capacity to 2,254,000 kw., with a peak load to date of 1,928,000 kw. registered on December 15."

Operating at a speed of 1,800 r.p.m. and at a steam pressure of 1,300 psi., the unit embodies the most advanced design features contributing to high efficiency and economy. Steam is supplied by two pulverized coal-fired boilers with a combined capacity of 100 tons of coal per hour. Boilers are capable of delivering 1,500,000 pounds of steam per hour. Allis-Chalmers Manufacturing Co. constructed the turbo-generator and Babcock & Wilcox the boilers.

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Long Dispute Ended

The $8,000,000 generating plant of the Indianapolis Power & Light Co. is back in Perry Township as a result of a decision of the Indiana Supreme Court ruling as unconstitutional a 1943 act reestablishing the original boundary line between Perry and Decatur townships. The decision ended a long-standing dispute between the two townships.

McPhail Named New Power Branch Head

Harvey McPhail, formerly assistant chief electrical engineer of the Bureau of Reclamation, has been named director of the bureau's new power utilization branch. He will maintain headquarters in Washington for about six months while the branch is organized and then move it to Denver, where he has been located.

The new branch will be one of five under which the Reclamation Bureau will carry on its activities. It will administer and supervise the operation of Reclamation's power holdings, maintaining liaison with the Interior Department's power division, which is Secretary Ickes' adviser on power policy and plans. It will in no way conflict with or impair the jurisdiction of the power division.

An Interor spokesman explained that Reclamation has long had a highly trained staff to design and construct power installations, but has never had much personnel which was intimate with power system operation and administration. The new agency will remedy this deficiency.

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Accountants Confer in Oregon Meeting

The accountant's place in the postwar planning of a utility company took prominent position on the program of the accounting conference conducted by the Northwest Electric Light and Power Association in Portland, Ore., December 13 and 14, 1943, for the first time since these conferences were started about one year ago. This was the third such round-table conference and was conducted by T. W. Fryou, Portland General Electric Co., who is this year's chairman of the Accounting and Business Practice Section of the association.

Personnel problems will be paramount in the transition period between war and peace, the group found. Many hired in recent months are on a temporary basis and will be replaced by former employees returning from the service. In the meantime methods and policies are changing, and the necessity for careful selection and adequate training of employees was emphasized.

Need was seen for uniformity in interpreting the classification of accounts as between charges to maintainance or to property, and it was pointed out that this required co-operation of engineering departments which should furnish all the physical facts. Several border-line cases were cited, as replacing condenser tubes, rewinding transformer coils with perhaps a change of voltage or capacity, rewinding a generator for increased capacity, repairing a section of flume, etc. Consensus was that maintainance should be favored to the limit compatible with sound accounting practice, because of the tax contribution under present conditions, and only that portion of the cost which contributes to increased capacity or actual betterment of the property over its original condition should be charged to property.

Salary and wage policies in general are still presenting serious problems due to delay in rulings on increases by the War Labor Board and treasury department. In going to a work week above 40 hours, overtime payments to regular employees have thrown schedules of supervisors' pay out of line. Some increases have been allowed for employees under the $400 per month bracket.

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Terminology Committee Of A.S.M.E. to Meet Soon

Final consideration will be given suggested changes in terminology for the field of automatic control at a meeting to be held by the terminology committee, industrial instruments and regulators division, of the A.S.M.E., on Friday, January 7, at A.S.M.E. headquarters in New York City.

J. B. McMahon, acting chairman of the terminology committee, has urged all engineers who have definite comments or suggestions for revisions of terminology to get them into the committee's hands by the time of the New York meeting.

MEETINGS

Previously Listed

Missouri Valley Electric Association—Annual power sales conference, Continental Hotel, Kansas City, Mo., January 19-20. I. D. Pettegrew, director, 1527 Sharp Bldg., Lincoln 8, Neb.

American Society of Civil Engineers—Annual meeting, Engineering Societies Building, New York, N. Y., January 19-21. George T. Seabury, secretary, 33 West 39th St., New York, N. Y.

Canadian Electrical Association—Annual winter conference of committees, Mount Royal Hotel, Montreal, Que., January 20-21. B. C. Fairchild, managing director, 804 Tramways Bldg., Montreal, Que.

American Institute of Electrical Engineers—National technical meeting, Engineering Societies Building, New York, N. Y., January 24-28. H. H. Henline, secretary, 33 West 39th Street, New York, N. Y.

Sales Executives Conference—Netherland Plaza Hotel, Cincinnati, Ohio, February 3-4. H. E. Dexter, secretary-treasurer, 50 Market Street, Poughkeepsie, N. Y.

Utility Approves Construction Budget

A 1944 construction budget of $1,449,000 has recently been approved by the board of directors of Wisconsin Public Service Corp., Green Bay, which includes $1,339,927 for new projects and $115,073 for completion of authorized projects in progress, it is reported.

Approximately $300,000 of the authorized budget for the coming year is for expanded rural line construction under liberalized government restrictions.

Among the items for which WPB acceptance is most hoped, because of their highly essential character, are two interconnection projects and two major improvements to power system equipment. The largest interconnection project is at Oshkosh and is estimated to $280,000 and the second is at Elkhart Lake and will cost an estimated $91,000.

Budget engineers caution, however, that many of the items listed as desirable or even essential may not be possible to secure or to construct during the year and may be postponed.

Extension and enlargement of the Bayside plant intake tunnel better to accommodate the present units and to provide water capacity for future additions is projected at a cost of $80,000. Replacement of oil circuit breakers at Wausau west hydro plant at a cost of $51,000 is called for as a step in the progressive modernization of equipment there. Secondary to these two projects in probability are projects calling for expenditure of $53,000 for replacement of a turbine at Grand Rapids hydro plant, $25,000 for coal handling equipment at Bayside and $34,756 for relays and sectionalizing oil circuit breakers at Wausau paper mills.

Other items called for in 1944 range from the reinsulating of transmission lines and distribution lines and the increasing of substation capacity at several points to the rebuilding of certain gas properties.

Absent from budget allotments, however, because of previous WPB denial of materials are the previously budgeted major power system substation improvements at Green Bay and the addition of another 30,000-kw. unit at Bayside. These shelved items are expected to be revived promptly.

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Detroit Edison Report

The Detroit Edison Co. reports that 290,546,490 kw.-hr. were sold to industrial customers for the month of November.

Output Up Again for 16% Increase

The output curve again reached a new high during the week ended December 18, according to figures released by the Edison Electric Institute. The amount of electrical energy distributed by the light and power industry during the week totaled 4,612,994,000 kw.-hr., as compared to 4,566,905,000 kw.-hr. the week previous. Figures for the latest week represent an increase of 16 percent over the 3,975,873,000 kw.-hr. distributed during the corresponding week in 1942.

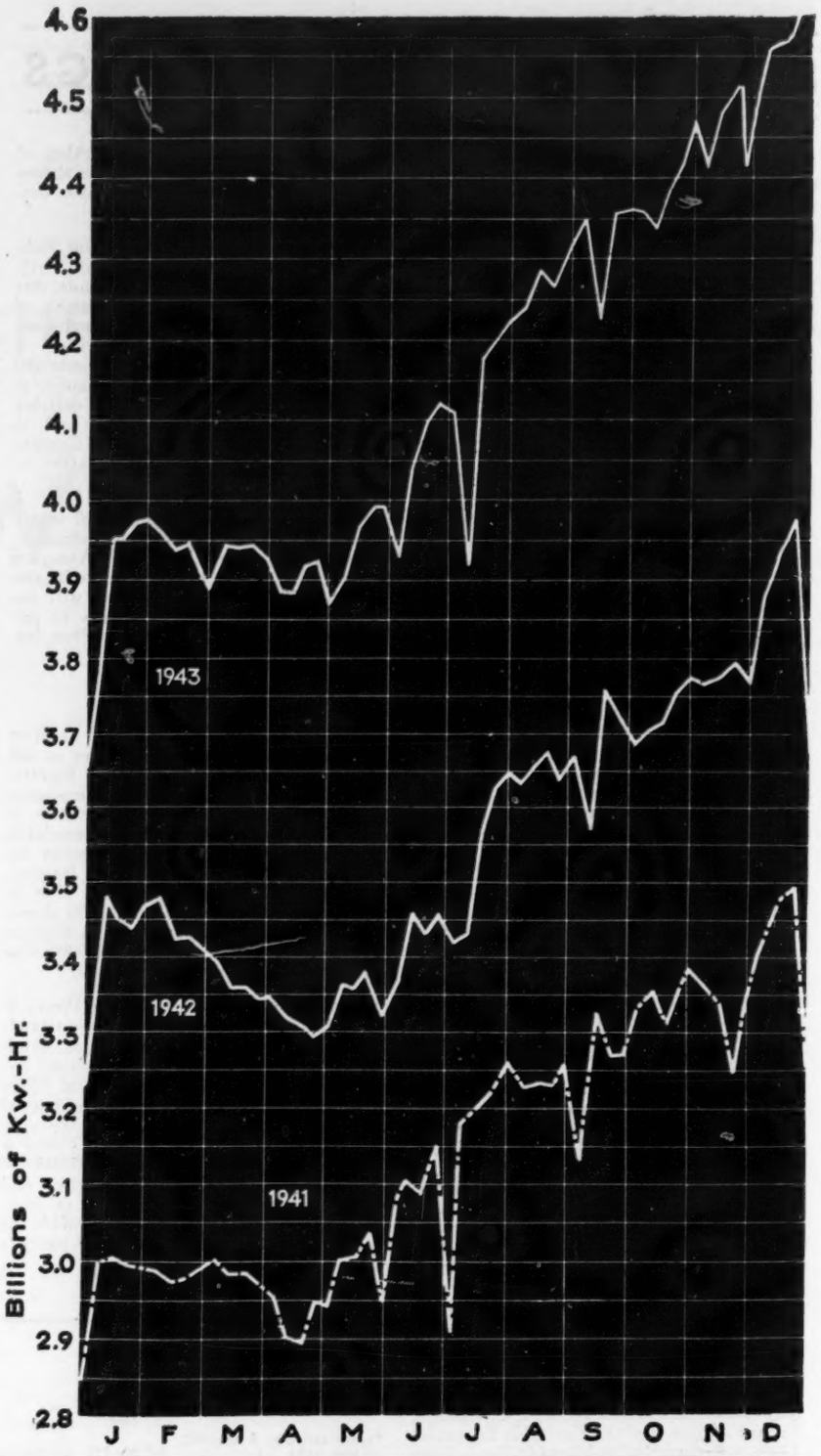
Again all of the country's seven major geographic regions contributed to the rise during the latest week. The Pacific Coast region continued to lead the country with a 31 percent increase over the 1942 week; the Southern States region, with a 19.4 percent gain, was in second place, and the Mid-Atlantic region, with a 16.3 percent increase, was in third place. The West Central region was indubitably at the bottom of the list with only a 6 percent gain. Greatest individual gain during the week was registered by the Southern States region with a 2.4 percent increase over its figure for the preceding week.

Weekly Output, Millions Kw.-Hr.

1943		1942		1941	
Dec. 18	4,612	Dec. 19	3,975	Dec. 20	3,495
Dec. 11	4,566	Dec. 12	3,937	Dec. 13	3,475
Dec. 4	4,560	Dec. 5	3,883	Dec. 6	3,414
Nov. 27	4,403	Nov. 28	3,766	Nov. 29	3,339
Nov. 20	4,513	Nov. 21	3,795	Nov. 22	3,247
Nov. 13	4,482	Nov. 14	3,776	Nov. 15	3,348
Nov. 6	4,414	Nov. 7	3,762	Nov. 8	3,368
Oct. 30	4,452	Oct. 31	3,775	Nov. 1	3,380
Oct. 23	4,415	Oct. 24	3,752	Oct. 25	3,341
Oct. 16	4,382	Oct. 17	3,717	Oct. 18	3,313
Oct. 9	4,342	Oct. 10	3,702	Oct. 11	3,355

Percent Change from Previous Year

	Week Ending		
	Dec. 18	Dec. 11	Dec. 4
New England	+ 7.0	+ 8.1	+ 8.0
Mid-Atlantic	+16.3	+17.4	+17.3
Central Industrial	+10.7	+11.7	+12.9
West Central	+ 6.0	+ 7.8	+10.4
Southern States	+19.4	+17.0	+17.9
Rocky Mountain	+15.0	+12.4	+14.4
Pacific Coast	+31.0	+30.3	+35.3
Total United States	+16.0	+16.0	+17.5



Deficiency Seen in Water-Supply Outlook

Subnormal stream flow, lowering ground-water levels and diminishing natural and artificial storage in the western Canadian provinces, Washington and the southern two-thirds of the United States were reflected in a geographical survey released recently by the Department of Interior in collaboration with the Canadian Water and Power Bureau.

Artificial storage is being heavily drawn upon, and in general the water-supply outlook for the immediate future in these areas is unsatisfactory, according to the survey.

Stream flow, lake levels and ground storage continue normal or above in most of central and eastern Canada, New England, Middle Atlantic States, Michigan, northern Indiana, Wisconsin, Minnesota, Iowa, North Dakota, Montana, Idaho, Oregon, California and northern Nevada. Because storage reserves in these areas are being well maintained, the outlook for continuation of normal or above-normal water supplies is favorable.

SEC DECISIONS—HEARINGS

The Securities and Exchange Commission, in a series of orders issued last week affecting electric utility companies:

AMENDED ITS ORDER of October 27, 1943, so that the proposed contribution of $1,000,000 in cash by Peoples Light & Power Co. to the Texas Public Service Co. shall consist of $750,000 in cash and $250,000 in U. S. Treasury notes.

PERMITTED THE CITY of Omaha, Neb., to intervene in proceedings on an American Power & Light Co. voluntary plan of reclassification into a single class of common stock, and 42 pages of "canned testimony" were recorded at hearings which opened last week.

REFUSED A REHEARING to Rochester Gas & Electric Corp. on a commission order for elimination of more than $5,280,000 of cost from the company's capital accounts. The commission termed that amount a "write-up" in valuation of Genesee River water rights and other intangible property of the corporation.

APPROVED CONDITIONALLY A PLAN for reorganization and simplification of the central management and servicing arrangements of the American Water Works & Electric Co. with the water operating and water subholding companies in its system. The decision stemmed from an investigation initiated at the request of the Board of Public Utility Commissioners of New Jersey at the request of a State Commission.

PERMITTED TO BECOME EFFECTIVE the proposal of the Wisconsin Public Service Corp. to hold a special meeting of stockholders on January 22, 1944, to approve various amendments to the articles of incorporation respecting voting rights of the preferred stock.

APPROVED THE PROPOSAL OF Public Service Electric & Gas Co. to reduce the aggregate stated value of its no-par common stock from $196,205,800 to $146,205,800. The amount of the proposed reduction, $50,000,000, will be set up in a separate account, designated "capital surplus," which with the company's earned surplus and other reserves will be sufficient, the company stated, to cover any adjustments of items on its books which may result from orders of the FPC and the Board of Public Utility Commissioners of New Jersey.

GRANTED THE APPLICATION of the Standard Gas & Electric Co. to sell for $800,000 cash its interest in the Market Street Railway Co. of San Francisco to A. C. Allyn & Co., an affiliate, and the Equitable Securities Corp. Standard Gas' holdings in the railway company consist of $863,094 open account indebtedness, 39,250 shares of 6 percent cumulative preferred stock, 25,500 shares of 6 percent second preferred stock and 61,900 shares of common stock.

APPROVED A PROPOSAL of the Ogden Corp. to dispose of its interest in its subsidiary, the Derby Gas & Electric Corp., to comply with the Holding Company Act through the sale of 91,577 shares of Derby Gas no-par common. However, the commission denied Ogden's request for exemption from its competitive bidding rule in regard to the sale of the stock, but it reduced the ten-day minimum period for reception of bids to a minimum of six days. The shares represent 62.46 percent of Derby's outstanding common stock.

APPROVED A PROPOSAL by the Maine Public Service Co. to issue $300,000 of thirty-year 3½ percent first mortgage bonds, due in 1973, and 2000 additional shares of $100 par common stock to finance its acquisition of the Caribou Water, Light & Power Co. for $500,000 cash. The bonds will be sold to three insurance companies at 102 and accrued interest to date of delivery and the common stock will be sold to Maine Public Service's parent, the Consolidated Electric & Gas Co., for $200,000.

PERMITTED THE New England Gas & Electric Association to acquire 3000 shares of $25 par common stock to be issued by its subsidiary, the Cape and Vineyard Electric Co., at $50 a share, or an aggregate of $150,000. The subsidiary will use the proceeds from the stock issue to pay indebtedness of $150,000 to the First National Bank of Boston.

Applications Filed

THE ASSOCIATED ELECTRIC CO. OF NEW YORK requested approval of a plan to sell its holdings in the Union Gas & Electric Co., operating in Illinois, in compliance with the geographic integration clause of the Holding Company Act. Associated would sell $528,000 of open account indebtedness plus $2,640 accrued interest, $202,000 of first mortgage bonds due in 1940 plus accrued interest and 7500 shares of $100 par value common stock, to William E. Vogelback of Chicago for $700,000 to be paid with a five-year purchase note.

A PLAN BY THE Cities Service Power & Light Co. for retirement of all its outstanding debentures and preferred stock, totaling $47,000,000. The plan would leave the Cities Service Co., parent concern of Cities Service Power & Light, as sole owner of controlling securities interest in the subholding company. Cities Service Power & Light currently has available $27,000,000 in cash for retirement of the securities and has made arrangements to borrow an additional $20,000,000 from banks to provide the necessary $47,000,000 to retire the publicly held securities.

Utility Reports

	Net Income 1943	1942
*American Gas & Electric and subs	$12,001,272	$11,356,578
*Arkansas Power & Light	1,536,010	1,526,531
*Dallas Power & Light	1,528,409	1,477,251
*El Paso Electric (Texas) and subs	609,320	529,753
*Engineers Public Service and subs	5,134,820	4,123,072
*Gulf States Utilities	2,063,757	1,717,382
*Minnesota Power & Light	2,016,492	1,468,283
*Northwestern Electric	656,271	650,999
*Puget Sound Power & Light and subs	5,153,653	3,103,564
*Savannah Electric & Power	262,730	174,255
*Texas Electric Service	2,044,570	1,517,367
*Utah Power & Light and subs	2,375,856	1,794,121

*Twelve months ended October 31.

A PLAN FOR REORGANIZATION of the Federal Light & Traction Co. involving a merger with six subsidiary operating companies. The new company would be an integrated operating system and would provide utility service in the states of Arizona and New Mexico. The subsidiary firms involved are the Albuquerque Gas & Electric Co., Deming Ice & Electric Co., Las Vegas Light & Power Co., New Mexico Power Co., Trinidad Electric Transmission Railway & Gas Co. and the Stonewall Electric Co.

Hearings Scheduled

DECEMBER 21: Proposal of the Florida Power & Light Co. to issue and sell $45,000,000 principal amount of First Mortgage Bonds, $10,000,000 principal amount of Sinking Fund debentures, and $5,000,000 principal amount of Serial Notes. At this time consideration will also be given proposals of the American Power & Light Co. and Electric Bond & Share.

DECEMBER 23: Requests on the plan of Electric Power & Light Corp., of Augusta, Me., to make a capital contribution of 30,000 shares of Louisiana Power & Light Co.'s $6 second preferred capital stock to Louisiana Power & Light.

JANUARY 25: Ordered a reconvening hearing this date in the matter of the Indiana Service Corp. and Clarence A. Southerland and Jay Samuel Hartt, trustees of the estate of Midland Utilities Co., for the purpose of adducing further evidence and closing the record.

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North Little Rock Gives Electric Bill Refund

The city of North Little Rock, Ark., will distribute a bonus about Christmas time to residential electric consumers in the entire district served by its system. It is estimated that 10 percent of the 1943 profits from the electric department of the city will be returned to users in the form of a "paid" bill for the current month.

Proposed by Mayor Neely, after a conference with Victor H. Beals, superintendent of the electric department, the City Council voted the refund, which amounts to a return of approximately $20,000 to residential consumers.

Mayor Neely told the City Council that this gift would not affect commercial or industrial customers and that the return amounted to a 10 percent reduction in light bills for the year.

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PSC Denies Rehearing

A petition of the Rochester Gas & Electric Corp. for a rehearing on a recent order to the utility to eliminate from its capital accounts more than $5,280,000 which was carried on its books as the cost of water rights and other intangible property was denied last week by the Public Service Commission.

THE POST-WAR

POWER PLANT

By A. E. KNOWLTON, *Associate Editor, "Electrical World"*

WAR is bringing forth or accelerating many technical developments which promise equipments and assemblies that will outstrip in time the achievements of the recent past in producing a kilowatt-hour at less cost with steadily improved dependability and facility.

War, too, is resulting in a slackening of construction of new utility-system fuel-burning power plants; this gives incentive and opportunity to break, to greater or lesser degree, with traditional practice.

Conservative Attitude

Both these factors suggest a new pace and a new pattern for the power-generating facilities of the immediate future.

There is ample evidence that the new potentialities are commanding serious attention, but the engineers and executives, ever conscious of their responsibility to patrons and participants in the business, take an understandably cautious attitude toward new devices and concepts which entail too much of a wrench from proved procedures.

By and large, therefore, the utility power systems of North America will build their new power plants or expand the present ones in keeping with the designs which typify their most recent additions. In short, there is no disposition to discard precedent and adopt in a rush the revolutionary changes which current technological and economic changes present. Nevertheless, there is a wholesome open-mindedness and willingness to accept the new developments as fast as they confirm their merits in terms of hard-headed economics, reliability, durability and simplicity.

Comprehensive Inquiry

All this comes from digestion of replies to queries addressed to practically all utility enterprises—private and governmental alike—having more than a few thousand kilowatts of total generating capacity in fuel-burning plants. The analyses herewith presented represent the opinions of utilities having a total of more than 16,000,000 kw. of fuel-burning generating capacity and consultants speaking for

several million further kilowatts. The consensus is therefore that of more than half the electric utility industry.

As in any similar search for a trend it was expected that there would be divergences of opinion on the several issues raised. These varying preferences reflect less individualism in design philosophy than has occasionally been charged against those responsible for the direction of generating station objectives and layouts. On the contrary, the differences are to be taken as the result of thinking toward plants and plant additions to serve a wide range of local requirements and conditions, among which full variations are foremost.

Salient Points

Briefed generalizations, without the qualifying factors which follow in succeeding pages in fuller detail, are these:

1. Plants will continue to be as large or as small as local conditions have warranted in the past.

2. Individual units will be wanted in current sizes, with due regard to the continued growth that justifies progressively larger units.

3. There will be no pronounced change in the dispersal or concentration of plants as dictated by pre-war considerations.

4. Dispersal of plants solely to afford protection against bombing is not viewed as practicable for sustained peacetime economics.

5. Standardization of turbine ratings and basic patterns is viewed with considerable favor.

6. Standardization of boilers is not viewed as at all comprehensively attainable at present in the face of all the variables encountered in fuel, ratings, pressures and temperatures.

7. Trend in steam pressures will be steadily but slowly upward as economies and reliabilities are confirmed for the higher brackets.

8. Present moderate pressures will persist where plants and units are moderate in size.

9. Thermal gains from the higher pressures are recognized as asymptotic and increased investments to achieve them will be scrutinized carefully, particularly where fuel is relatively cheap.

10. When the wartime advances in metallurgy become available, the superheat temperature can be substantially higher than the present 950-965 F. limitation.

11. If fuel costs go up and stay up relative to investment costs there will be an incentive to strive for higher thermal economy.

12. Only a pronounced change relatively in fuel costs and investment charges will disturb the long term trend toward ever better economy even though recent gains are tapering thin.

13. Retirement of obsolete, inefficient plant facilities will in itself tend to improve the industry's recent national-average achievement in thermal economy.

14. More furnaces than before will be designed to burn two or more fuels so as to guard against future shortages in supply or delivery.

15. Increased amounts of automatic controls will be installed to promote safe and economical operation under fluctuating loads.

16. Automatic controls will also be installed to reduce wear and tear and, therefore, maintenance on equipment subjected to variable loads.

17. A growing awareness is that insufficiency of condensing water for inland systems will have an effect on location and design of stations.

18. Cooling towers and spray ponds will for the most part be used in preference to the other enumerated alternatives where condensing water is scant.

19. Stack-dust elimination is rapidly becoming a "must" for plants in populous areas.

20. Superposition will be a relatively small factor in post-war plant design.

21. The mercury turbine is considered still to be in the development stage, with economy and reliability yet to be assured.

22. Despite their inappropriateness for many utility systems there is a growing willingness to consider internal combustion engines as adjuncts of steam-power systems.

23. The gas turbine is considered a challenging prospect, but involved as yet in early stages of development.

24. Mobile power plants will be a small factor in the expansion of existing utility systems; they are viewed as essentially a wartime development with very limited appeal for peacetime usefulness to power systems.

25. The forced circulation boiler is viewed as in the early stages of development, but promises to offer savings wherever the highest pressures are deemed justifiable.

26. Outdoor power plants hinge on favorable climate and some plants so situated will be built "outdoors" to make an appreciable reduction in cost of the building structure.

SIZES OF UNITS AND STATIONS

Generating units and generating plants of the post-war era will trend to much the same sizes as have ruled in recent practice. There is nothing to indicate a movement away from the patterns that have been set up in recent years for either the metropolitan or the diffused systems. Threats of bombing or of sabotage are not deemed to be a determining factor in the choice of location of a plant, the size of the plant or the size of the units. In fact, many engineers second a municipal engineer in asserting that consideration of national security against bombing or sabotage should not influence the decision on size of plants or units.

Present Magnitudes Will Largely Continue

Present patterns of utility development are manifestly satisfactory in general. Economic performance and emergencies like floods and hurricanes have confirmed the existing layouts and, in general, there is little disposition to depart from them in further evolution. Metropolitan systems will, because of limitations of sites, add units in existing plants until they attain sizes of from 300,000 to 600,000 kw. and, for the sake of economy in capital, fuel and manpower, the units will continue to be large. One positive check is, of course, the limitation of condensing water and that is forcing consideration of more remote sources in several areas. The systems in smaller cities and particularly those with scattered low-density territory are favoring stations of not over 100,000 or 200,000 kw. and units that hover about a 30,000 kw. average and reach up to 50,000 kw. as a typical maximum.

Factors Influencing Trend of Sizes

Factors which are continuing to rule in these preferences for capacity dimensions and concentrations are these:

(a) Scattered systems justify use of small interconnected plants near load centers.

(b) Uninterrupted service is facilitated by multiplication of stations.

(c) Large units offer superior economy, but smaller units tend to reduce reserve capacity requirements.

(d) Numerous small units and plants run up the investment and personnel requirements.

(e) Load concentration, fuel availability, storage and transportation and condensing water constitute a primary composite guide.

(f) Station size is fixed by optimum balance among such factors as fuel cost, increased carrying charges on plant and transmission costs.

(g) Small stations are occasionally favorable for sizable concentrated power demand of single customer offering waste fuel in negotiation for energy.

(h) Feasibility of advantageous interconnection to reduce over-all reserves and trade in hydro can dictate a location and size of plants.

(i) Long high-voltage, high-capacity lines are often not justified by a wide territory of low load density; continuity of service, flexibility to meet varying loading, regulation of voltage and power factor are pertinent influences favoring scattered stations of moderate size.

(j) Standardization of unit sizes would tend to promote multiplication of plants because it should temper the cost of the sizes most likely to be standardized.

(k) Power concentration for economy of mechanical performance and investment intensifies the task of providing adequate breaker interrupting capacity and complicates the electrical protective pattern.

Little Change in Ratings Planned

These are not new principles. They were reported in substantiation of the common feeling that hardly anything new has happened to disrupt the analysis which has guided past decisions. Sizes of units and of stations are apparently going to follow the pattern of the past except as modified by growth in load, by dispersal of industry, by standardization or by changes in fuel availability and cost. Larger than ever units are likely to be wanted for metropolitan stations if they can be designed and if there is a situation where their size does not hamper flexibility in reserves and economy of operation.

Protection Against Bombing

Protection against bombing by dispersal of plants is, as has been said, not a factor in the present thinking for future power system patterns. The feeling seems to be that bombing has become so accurate that scattering of plants except as resulting from

diffusion of industry would be of little avail. Underground plants or war emergency plants that were set up solely for war production, with efficiency an incidental consideration, seem to be the primary suggestion.

Except in enemy countries the reported damage to power plants has not been such as to prompt anything beyond a modest consideration of disposition of facilities within a large plant in such manner as to minimize multiple damages. In short, metropolitan plants will have to be few and large anyhow, and the logical scattering of plants on widespread systems will achieve the protective objective in those instances; scattering will be amply checked by the desire to centralize control, minimize number of operating organizations, save on real estate and structures, keep over-all costs per kilowatt down and still serve load centers without incurring undue amounts of bulk transmission of steam-generated energy.

STANDARDIZATION OF EQUIPMENT

Proposed programs for standardization of ratings and patterns of boilers and turbines are arousing extremes of encouraging support on the one hand and lukewarmness tempered with outright skepticism on the other hand. Most of the forthright concurrence pertains to turbine standardization and most of the doubt quite naturally applies to the boiler. But even in the case of the turbine there is a lack of unanimity; one will see no handicap to complete fixing of pressure, temperature and number of bleed points, another wants ample latitude on the number of bleed points and on corresponding steam conditions. One will fear that standardization will stifle progress in thermodynamic efficiencies, another be intent on deriving the prospective paring in price that should accompany sharing of savings in production cost. All are pretty much agreed, however, that any sizable degree of standardization would expedite delivery dates, accelerate completion and energizing of plants, facilitate replacement of parts and take complexity out of maintenance. With us for many years there will be the "non-standard" equipments in existing plants necessitating some continued provision of these equipment designs and of their parts.

The rub in the case of the boiler is the wide variation in fuel properties for different areas.

Price Related to Volume of Business

In some quarters there is conviction that standardization is desirable if the electrical industry is to maintain its place in the national economy. Price differential is wanted as an inducement to buy standardized units. It is amply recognized by some that this reduction is contingent, not upon a paper set-up, but upon orders that will result in a sufficient number of standardized units going through the shops of any one manufacturer with consistent continuity. In any event the standardization should proceed to a point where definite economies could be stated so that the purchaser can tell precisely how much it would cost to obtain a "special" design over and above the cost of a comparable standardized unit.

Any Compromise Should Not Hazard Reliability

Standardization is not wanted if it leads to compromises which entail an appreciable sacrifice in the economy of operation, freedom from operating mishaps, reliability over extended periods and flexibility for local requirements that can be obtained with present equipment even if it is not considered in conformity with the standards.

Some engineers definitely have no fear of such untoward consequences, at least in the case of turbines; it is even said that it is frequently the specialized designs that present the annoying and unanticipated troubles.

Standardization Should Not Check Progress

Even those who assert they are much in favor of standardization and say they do not want to be guilty of individualism in design do want to be assured that standardization must leave ample proving ground for pushing the frontiers outward. Freedom of design, within the bounds of standardized ratings and configurations, must encourage the incorporation of thermodynamic and metallurgical advances that will transcend the present practical limits of stresses, temperatures and heat economies. An interesting suggestion is made for fusing standardization with wholesome evolution. It is that any alterations or departures from prescribed standards should call for a premium which should be large enough to cover the additional expense of

manufacture and also carry an excess which would not only discourage unjustifiable departures but create a fund for development both of new standards and of progressive design.

Scope of Appeal of Standardization

Scrutiny of the replies leads somewhat to the conclusion that industry executives are largely those who look hopefully for the benefits of standardization in terms of plant outlay, but that it is the engineers' replies which warn against the restraints which would hamper station designs giving best over-all results in terms of local loadings, fuel and limitations presented by existing plants. Even executives, however, in the smaller companies fear that such standardization as may be evolved would tend to reflect the higher pressures and temperatures which have largely been fostered by the larger utilities. Relatively cheap fuel areas are content with slower upping of steam conditions. In fact, it is said that, up to medium pressures, present design engineering has practically concurred on the various requirements for heat balance equipments which in many instances could be congealed by standardization at present levels and ratings.

Price Differential a Dominant Incentive

There are those among users who are frankly skeptical about obtaining any substantial paring in prices per unit of rating by means of standardization. Diametrically opposed is the expressed belief that the differential in first cost can logically be great enough to compensate for the necessity of buying a half-size larger unit than analysis would justify in an unstandardized field.

Much of the preceding consensus pertains alike to turbines and boilers, with the proviso that boilers will be far harder to mold into a standard framework of sizes and patterns than turbines.

Turbine Standardization

Within the confines of the foregoing qualifications there appears to be majority support for the proposals for standardization of turbines. Categorical support for the extraction, temperature and pressure stipulations of the A.S.M.E. proposed standards is about the extreme of support accorded.

"Strongly in favor" is a common attitude, coupled almost invariably with the expectation of a price inducement and a hope that compromise values will not alienate too many latitudes for choice in the present arrays.

Call for Non-Standard Units Will Persist

Reticence is manifested by those who contemplate additional superposition or the fitting of further condensing units into the available space on the steam régimes of existing plants; it is expected that units outside the family of standardized patterns would be required for these situations. Consideration is also asked for differentiation between turbines for utility and for industrial requirements. It is urged that utilities offer higher load factors in normal times. The annual fuel outlay is often approximately equal to investment-carrying cost on the turbine, and thus a relatively small loss in internal efficiency through compromise of bleeder location to accommodate the entire turbine market would dictate an offsetting reduction in price. Quite in contrast with this is an opinion that the first cost of a turbo-generator is such a small item in plant outlay that variation of a few percent in price would not materially affect the total investment for additional capacity.

Coal Cost a Factor in Standard Steam Conditions

Accord for standardization in the range 10,000 to 30,000 kw. is strong but coupled with the qualification that steam pressure and temperature should not be fixed above prevailing levels on the ground that it would not be economical to gain higher fuel economy (at higher unit cost) in the face of local supplies of low-cost fuel. Availability of such fuel even precludes the resort to hydrogen-cooling of the generator because the losses averted are not worth the outlay.

One very specific desire for standardization went so far as to name 850 psi. for machines of 25,000 kw. and up, total temperature 900 F., from extraction points, 3,600 r.p.m., tandem-compound, six-bearing design with direct-connected exciter.

Boiler Standardization

Almost universal is the feeling either that boilers have been standardized well enough in the small and moderate ratings (up to 250,000 lb. per hour) or that the over-all efficiencies of today's stations are still so poor, despite the immense improvement of recent years, that initiative toward better cycles, better efficiencies and better reliability should be encouraged and not thwarted by the restraints of standardization. It is felt that real progress in this direction is now in the making. Equally common is the realization that boilers are a tougher problem than turbines if the attempt goes beyond the values picked for the turbine schedule.

Fuel Variables Impede Boiler Standardization

The viewpoint is taken that the boiler is a structure and not a piece of equipment, rather an assembly of elements chosen to fit the local fuel and combustion dictates. Boiler standardization, therefore, presents the risk of greater interference with station-design objectives than in the case of turbine standardization. Thus, in the case of the boiler, there are many who flatly say they are not in favor of an effort to standardize boilers in either ratings or patterns of assembly. It is recognized that manufacturers have already standardized many of the components in production and that assemblies can be devised to meet the widely varying characteristics of loading and of fuels. High ash, high sulphur and high moisture in the coal of one region demand a boiler widely different from the boiler and furnace that can be 20 percent smaller for the same output if it handles the coal of the Atlantic seaboard with only one-fourth or one-fifth as much ash. Oil as an alternative to coal comes in to complicate the situation still further, because there is often a 15 percent differential in its favor over typical coals.

Production Volume and Price Differentials

Still another factor impeding the standardization of boilers is the fact that the boilers ordered for a plant expansion job are not necessarily companioned in rating to the turbines purchased. This comes about because of superposition or the desire to retire some old boilers also serving other turbines off a common header. As a consequence, the variety of ratings going through a given manufacturer's shops are far less likely to provide the requisite continuity of production flow than in the case of turbines. Even with duplicate orders simultaneously from a single utility the differential is reported to be only 2 to 5 percent, so the price incentive toward standardization is not particularly potent.

In short, the practicability of boiler standardization at the present time is viewed with skepticism but with willingness to study the potentialities.

PRESSURE AND TEMPERATURE

Trend in steam conditions consists of an upward movement toward the 1,200-1,400-psi. bracket, but an unwillingness to hazard much above 950 F. in total temperature until the requisite metals can win confidence. The whole procession as to pressures is a block shift whose pace has been matching the velocity of research and of reliability gains. Those in general who lag behind this mass movement are manifestly those who have small plants, steam only as standby, low-grade fuels that will not perform well above some 800 F., or fuel so cheap that expensive refinement is unprofitable. Nor does the block shift promise an early invasion of the 1,700-2,500-psi. bracket.

"What do you consider is the highest pressure and temperature combination justifiable for your future designs?"

That was the question propounded and it had "your" in it. A few answers can be interpreted as being what the respondent thought was the most practicable for *anyone* to use in the light of today's metals and metallurgy. This can likewise be inferred from the accompanying chart. In general, however, the pressure and temperature values stated are those which are favored specifically for future additions to the respective systems.

There are evident two factors which directly affect the upper temperatures set down. One is, of course, the unwillingness to exceed the 950 F. total temperature limit set by the available metals. Another limitation, equally commonplace, is that coals with ash of low-fusion temperature cannot be burned without slagging difficulties in the superheater if an attempt is made to run total steam temperature beyond 750 or 825 F.

Fuel Cost a Ruling Factor

It is quite naturally the smaller plants on systems with scattered load centers that favor the moderate pressures. The metropolitan companies and those with heavy interconnections dominate those who are willing to move into higher pressures; among this group, however, are several who see the higher values only for superposition or for sustained high price of fuel. Where fuel is still relatively cheap it is rather flatly asserted that there is little advantage in paying more per kilowatt to achieve negligible gains in fuel cost. This attitude confirms the inference drawn statistically in the Fourth Steam Station Cost Survey (ELECTRICAL WORLD, December 2, 1939) to the effect that it does "not seem to pay to spend a lot on refinements to achieve high thermodynamic performance." In one or two instances where relatively high pressure has been used it is planned to revert to more moderate pressures for subsequent

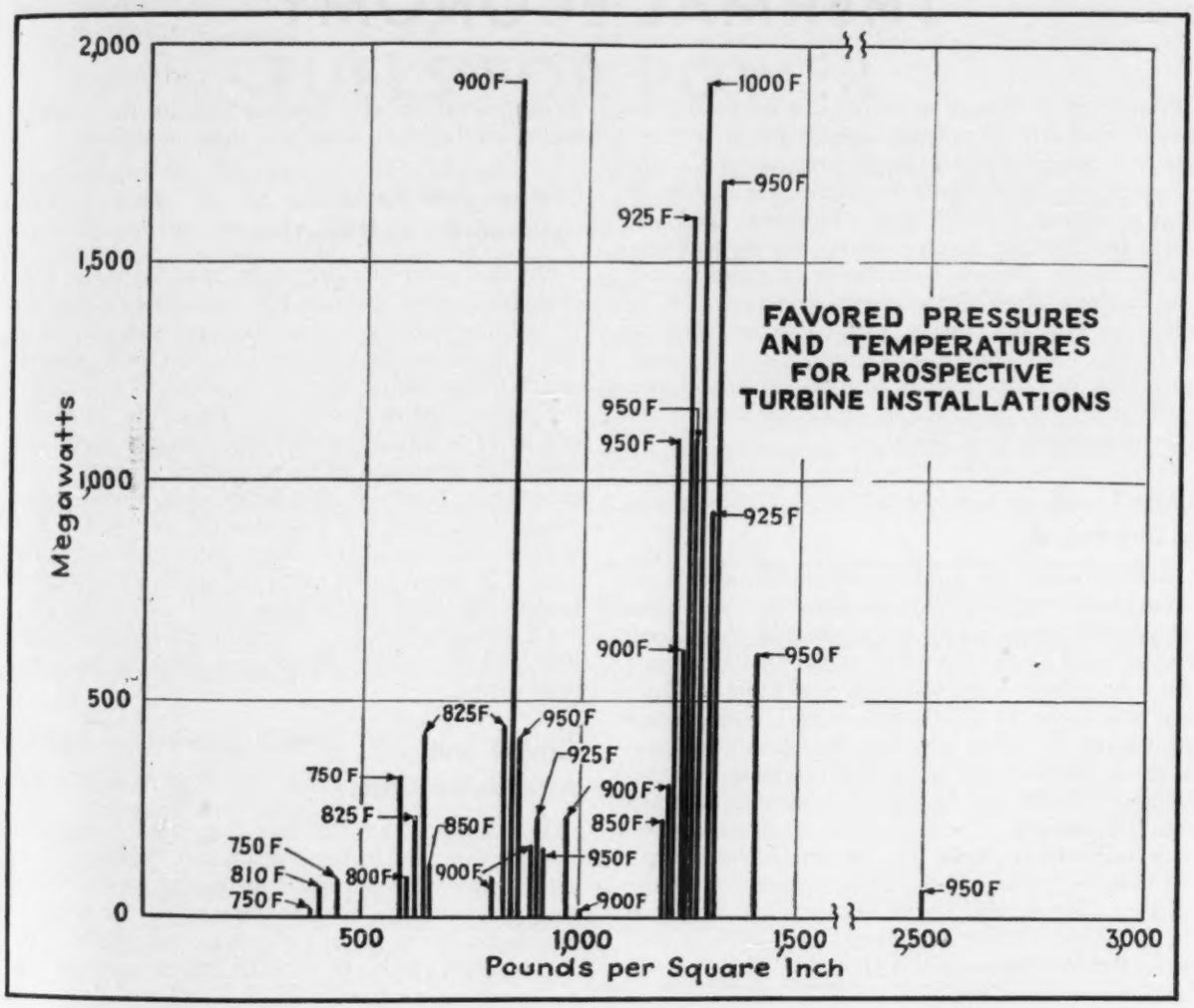
capacity; the reason given is that increased unit costs outweighed the expected operating gains. Even 400 psi./750 F. proved dubious in one instance because of high cost per kilowatt. Manpower conservation by automatic controls is deemed more important for small plants than thermal efficiency in the face of cheap fuel.

Low Generating Cost Wanted

Prospect of higher coal cost is one commonly mentioned factor pushing the steam conditions upward. And, of course, such consideration as will be given to further superposition will enhance the block already centering around 1,200 psi. Cautious designers who are thinking only of condensing units couple with their willingness to adopt those moderately high pressures the proviso that they want lower generation cost and certainly no less reliability of operation than they now enjoy with lower steam conditions. To offset their hesitancy is the assurance that the higher values give a plant that is "efficient, reliable and readily workable."

Reliability of Prime Importance

Fringing the discerned mass trend there are the supercautious who say they still consider 900 psi. and 950 F., or thereabouts, as present practicable limits. At the other edge of the fringe can be found those who, having ventured to go 300 psi. higher, would match with an additional unit without hesitancy and would not be averse to still more upping if the technical and economic proof accompanies the proposal. They seem not to share the timidity of others who feel that high pressure-temperature



means unreliability unless nursed by highly skilled labor. Compact systems can apparently afford to risk pioneering, but some with long transmission exposures and few sources want steam reliability. In fact, reliability is a more commonly used term than any other in the discussions canvassed.

Consulting engineers divide as do their clients and the independent engineers on the matter of steam limits. Even up to 2,700 psi. and 1,000 F. with 1,000 F. reheat would be supported if wanted, but with this goes the admission that the optimum values lie at lower boundaries. It is felt that future work will have a place for 2,000 psi., but how commodious a berth will depend on advances in metallurgy not yet widely revealed or in fact surely attained. A contrary group ask whether anything above 850 psi. will be worth its cost for the time being, citing that the whole range from 800 to 2,000 psi. at 900-1,000 F. with four bleed points proffers only a 6 percent spread in B.t.u. economy. The thermal and pecuniary gains are thus viewed as asymptotic and the reliability factor assumes prime importance with engineers serving sizable systems.

Open Discussion Desired

While the matter of pressures and the associated temperatures hang upon research in metals, there is indication in the replies that it is unwise to discuss the developmental troubles in closed experience sessions. Such procedure is viewed as excluding the contributions from equipment manufacturers whose field engineers and laboratory experts are much closer to the research phases of the metals problem than station design and operating engineers can possibly be.

THERMAL ECONOMY

Objectives of thermal economy can hardly be discussed independently of decisions faced in connection with choice of pressure and temperature. There is overlap in the thinking on these two aspects of what is virtually a single issue. However, there are points brought out which were not correspondingly treated in the discussion of choice of pressure and temperature. Fuel characteristics and fuel cost, as would be expected, are the primary factors, but by no means the dominant ones; there is not too good agreement on the relative position of importance assumed by the other factors, as will be seen in the following digest of opinions.

B.t.u. Trend Is Downward

At the outset the prime consideration is to turn out a kilowatt-hour at the lowest over-all cost. The B.t.u. willingly expended to accomplish that objective will vary all the way from under 10,000 for large plants with large units and high local costs for land, fuel and labor to 17,000 where coal is of poorer quality and the other costs are correspondingly low. A more popular pair of values typifying the two groups is 11,500 and 14,000 B.t.u. per net kilowatt-hour. These group-average values of current objectives for post-war plants are substantially better than the values that were being achieved late in the last decade. The Fourth Steam Station Cost Survey in the ELECTRICAL WORLD of December 2, 1939, showed performance values nearer 15,000 and 17,000. Justification is found in the cycle progress which has been accomplished in the interim and in the present higher level of fuel, labor and equipment costs.

Costlier Fuel Favors Lowered B.t.u. Objective

On this point of rising costs there are many who evidently expect the cost for the next two decades to be substantially higher than for the preceding two. Some say that higher fuel costs will warrant efforts toward better thermal economy. Others have the feeling that costs of fuel, labor and facilities will rise more or less in parallel and thus not materially affect the optimum B.t.u. objective. There is no gainsaying, however, the belief that small plants where fuel costs are low just do not justify the refinements warranted in large plants in load-density areas. It seems to be taken for granted that higher investment costs accompany most efforts to pare B.t.u. consumption and that favorable fuel and favorable fuel costs definitely act as a check to the economy drive.

Capital and Attendance Costs

It is asserted that carrying charges on investment may be expected to increase because of difficulty in securing investment capital for enterprise where the return to investors, as in the case of electric utilities, is reduced by regulatory philosophy and action. The combination of this trend with that of probable rise in operating expenses will, it is believed by some,

temper the incentive to build plants for ever higher efficiencies. In fact, one comment is that only great unforeseen departure from these parallel trends can foster any pronounced desertion of present levels of B.t.u. economy.

Limits to Refinement Desirable

If only fuel and labor were to increase it is inferred that higher investment cost per unit would be logical to get better B.t.u. economy and hold busbar costs in line. Less coal per kilowatt-hour helps independently, because there is less coal to handle and less ash to combat and handle. On the other hand, over-refinement in the direction of B.t.u. efficiency is felt in many cases to increase maintenance costs to the point where they more than offset the saving in fuel outlay.

Less highly trained operating labor is required when not too strong a drive is made for the better fuel economy for which the higher pressure and temperature plants are chosen.

Obsolescence of Present Equipment

Not all of this pro and con regarding operating and capital costs need be restricted to capacity contemplated for future increases in load. The optimum B.t.u. economy is thus flavored not alone by superior economy of supplementary capacity but also by the foreseen need to obviate the removal from service for repairs which marks semi-obsolescent equipment now being crowded for long hours of sustained output.

Competence of Operating Staff

Consultants include some who say they have recommended B.t.u. values substantially under 10,000 in recent instances. This was coupled with the word of caution that actual achievement of such values in routine operation depends on the competency of the operating staffs. Advice is that it is unwise to engage in commitments which lie outside the capabilities of the forces in the plant.

FUELS FOR POWER

Coal remains the dominant fuel for prospective generating plants. In the thinking of designers it outranks oil eight to one and natural gas nine to one in favor as a primary fuel. Oil, in turn, outranks gas ten to seven as a secondary fuel.

These statistical measures are the result of play of several factors over and above the natural tendency to use the most economical fuel available in the local area. The factors cited are (1) the range in over-all cost per kilowatt-hour, (2) the rising costs, (3) the predicted run-out of petroleum, (4) the cost of hauling ash in coal, (5) extension of natural gas pipelines. Discerned, therefore, in comments is a definite trend toward designing furnaces, boilers and burner set-ups so that switch to alternative fuel can be made quickly to meet any shortages or take advantage of any cost differentials. This expands the trend which had already been intensified along the Upper Atlantic Seaboard when oil became scarce.

Dual-Fuel a Growing Trend

Provision is going to be made in numerous plants for the conversion from one fuel to another. It appears that it usually entails no appreciable initial expenditure, but does mean providing space in the design for delivery, storage and handling (particularly of coal). Little is said of the usual decrease in output when converting from oil to coal, but it can be assumed that furnace and boiler will have to be generously enough designed or the sacrifice met by margin of steaming capacity in other units. Few mentions were made of the prospect of having to forego fuel oil because of the revived fears about the ground reserves.

Most of the comment carries the flavor of meeting the shortages in supplies and the competitive savings by putting plants on a dual-fuel basis. It seems to be confirmed that designs can inexpensively be laid for use of two fuels and the adaptation deferred until circumstances warrant. In interconnections the dual-fuel position is deemed an asset for service security as well as for economy, freedom and flexibility.

Design Preferences for Fuel in Plants of Designers Representing More than 16,000,000 Kw.

Primary Fuel	*Kilowatts*	*Relative*
Coal	9,602,000	1.000
Oil	1,179,000	0.123
Gas	1,118,000	0.116
Secondary Fuel		
Coal	182,000	0.019
Oil	2,152,000	0.224
Gas	1,466,000	0.152
Standby		
Coal	14,000	0.001
Oil	95,000	0.010

Processed Coal, Natural Gas

Along the Eastern seaboard there is frequent mention of natural gas as an alternative fuel if, as and when pipe lines are extended into the belt. Meanwhile, those systems most remote from both the coal fields and pipe lines say they cannot afford to pay freight on ash in coal and therefore need the best-grade fuels of the East. There is offered the suggestion that there may be justification for a limited amount of processing of coal, particularly in the case of combination utilities producing both gas and electricity. No details were vouchsafed.

Coal Retains Dominance

Thus, despite the admitted prospects of higher delivered cost for coal, the likelihood seems to be that coal will stay far out in front as electric utility fuel, but that more effort than ever will be made to design plants able to use alternative fuels for the sake of economy and to escape pinches.

STACK-DUST ELIMINATION

Elimination of stack-dust is recognized as steadily becoming more of a "must" item for future power plant designs. The phrases used to identify the causes for the trend are public opinion, civic ordinances, public relations, programs for cleaner atmosphere, public regulations, nuisance hazards. Coal-burning plants remote from populous centers are deemed in some places not to need special provision for elimination of stack dust; others say that provision for later installation has already been made in recent plants and that it will be continuing practice because surroundings may change in character. Generally, the consensus is that stack-dust elimination can only be omitted in the future where the fuel does not necessitate it or where the public will not be adversely affected by any emission of solids from the stack.

Ash Removal Promotes Several Objectives

Installation of dust-removing facilities permits shift to grades of fuel which run high in ash. Lignite, in particular, is mentioned as contributing relatively large quantities of cinders and fly ash at high ratings.

Removal of the fly ash as early as possible aids in the reduction of wear (and maintenance) on induced-draft fan blading and casing, ductwork and breeching.

Research may reveal profitable use for reclaimed ash.

One recommendation is that removal of stack-dust facilitates successful camouflage of power plants in future wars.

CONDENSING WATER

Plants on the seaboard, on sizable rivers or on lakes have no problem with condensing water so long as they can find appropriate sites. Other plants less favorably situated cite moderately critical or prospective shortage of condensing water. No immediate distress is indicated in any quarter, however. The numerous alternatives mentioned nevertheless show that insufficiency of condensing water is a growing possibility. That it is being anticipated in thought and in preparatory designs is evidenced by the following methods mentioned as affording ways of circumventing a scarcity of condensing water. These are named in the order of preference on a national basis, the first two standing out five to one above all others:

1. Cooling towers—(a) No special form indicated. (b) Induced draft. (c) Forced draft. (d) Natural draft.
2. Spray pond.
3. Surface recirculation.
4. Deep wells.
5. Superposition.
6. Extraction heater applied to turbines with bleeder connections to lessen steam flow to condenser for given output.
7. Internal combustion engines.
8. Gas turbine.
9. Extension of tunnels to reduce recirculation.
10. Dredging to reach receded channel.
11. Compensatory design of condenser.
12. Use higher pressure and temperature for station design.

13. Mercury turbine.
14. Compensatory design of hydraulic intake and discharge.
15. Designing boiler and turbine to develop sufficient output with sacrifice in back pressure when using warm water in condenser.
16. Storage of floodwaters in pond for use in lean water period.

Also cooling towers are mentioned as used to dispose of the heat picked up by water used to cool turbine oil and generator air and thus aid the units in the station to deliver maximum feasible output.

Cooling Towers and Spray Ponds

Reluctance to resort to cooling towers or spray ponds until unavoidable is generally noticeable, but offsetting it is a suggestion that accessibility to natural and comfortable supplies of condensing water will not loom so important as engineers become better acquainted with cooling towers. Vigorous preference by some for the forced draft type was overridden by equally positive stand of a more numerous group favoring induced-draft type. One company has built and will build plants near fuel supply even if only subsurface water is available, because of confidence in cooling towers.

Economic Comparison

It is said there is little economic difference between towers and spray ponds. A somewhat diverging opinion is that, while other alternatives are much preferable, final resort to spray ponds is better for larger plants and cooling towers for smaller plants. Threading through all comment is some feeling that much improvement has been effected in recent years in cooling tower design.

Wells

One system favors gravel-packed wells designed to utilize fully the available ground water; the primary application is for generator-air cooling, but the excess capacity is used to temper the condensing water supply in warm weather.

AUTOMATIC CONTROLS

Automatic control stands in wholesome favor for the post-war plants, particularly those with variable load. Several go so far as to say that it has been installed to as great an extent in the past as the available control systems permitted and that it is inconceivable that future plants could be built without comprehensive automatic devices. One cogent reason given for boiler controls is that large modern boilers have so small a quantity of water in them that it would be absolutely unsafe to trust the regulation to human agencies unless the plant can be operated so as to be held to reasonably constant or base loading.

Is Labor Saved?

Whether labor is saved by application of automatic controls in the steam station is a moot question. Some claim that they enable handling of large outputs with minimum labor and many merely include mention of manpower shortage and reduced station labor along with efficiency, economy and reliability as ends achieved. In the opposite camp are those who assert that the control mechanisms have not reduced attendance labor, although they do admittedly afford the opportunity to centralize controls in one or two locations.

Load Fluctuations an Incentive

Practical operation is reported to be next to impossible without ample control because of the rapidity with which load changes or emergencies may require simultaneous operation of numerous auxiliary equipment. It thus appears that automatic controls are logical components of the increasing trend toward swapping reserves by interconnection. The reserves have to step in quickly and often with very brief warning.

Efficiency and Economy Promoted

Controls are stated to be necessary for maximum thermal efficiency and more economical operation. Thus they rise in importance wherever and whenever fuel increases in cost relative to other items. By reducing fuel use control systems offset any increased cost per B.t.u. From several quarters testimony is presented that the controls have proved satisfactory and that future units will be similarly equipped. From very few places was there intimation that the installations do not all perform as hoped. On the contrary, it is more frequently asserted that the systems have proved so superior (for combustion, feedwater and fuel control) to manual control that

future plants not fully equipped with automatic controls can hardly be visualized; they are often accepted as inherently part of a modern plant.

Wear and Tear Reduced

Maintenance of steam and water equipments is reported to be reduced by the use of automatic controls. It affords close attention to the regulation of feedwater, temperatures, flows and the supervision of boiler chemicals. The derived benefits are less fluctuations, less corrosion and less of the wear and tear that accompany fluctuation in stresses, loads and thermal changes. Incidentally, there is evidence that sustained and increasing reliance on automatic equipment is encouraged by the small percentage to total plant cost which is represented by the outlays for the automatic control installations.

Responsibility of Personnel to Be Considered

Caution is expressed that automatic control should be installed only up to the point where it can assuredly do better than humans can do under the circumstances. It should stop short of the point where station operators are relieved of the necessity for thinking. Otherwise operators will prove absolutely helpless in time of station trouble. No human being can rightfully be expected to be alert and act quickly and intelligently in an emergency if the daily duties do not call for frequent quick and sound thinking. Stations are calling for higher and higher skill and competency of operating staffs; these staffs must not be allowed to lose interest in their great responsibility by allocating too many functions to automatics. Also too extensive and elaborate automatic control may cause more trouble in keeping it maintained in working order than a corresponding amount of attention to turbines, boilers and auxiliaries left to the province of the operating staff.

Further Developments Desired

Hope is expressed that further improvements in existing designs or new designs involving electronic devices will make unmistakable contributions toward reduction in operating personnel and toward greater reliability not only of the control equipment but of the station as a whole.

Systems with diesel units report studies toward justification and development of further automatic controls for that field particularly as they go to larger units and larger concentrations.

MERCURY TURBINE

Present thinking indicates that the mercury boiler and turbine are destined to have a slow introduction into utility power plants. It is being given serious consideration in a few instances and there is a qualified willingness to give such consideration in other places. That qualification is usually contingent upon acquiring more confidence about the economic merits or the operating reliability of the mercury superposition cycle. Others report they have no plant situation appropriate for mercury superposition. Still others give specific circumstances which are adverse or would have to become persuasively favorable before they would contemplate a superposition involving the mercury cycle. The largest group feels that the equipment is still in a development stage; part are skeptical and part are engaging in watchful waiting.

Score Card on Mercury Cycle

Subject to minor departures resulting from channeling diverse phrasings into a limited number of categories the score among utility engineers, executives and consultants is about as follows:

1. Cycle not commercial, in development stage.. 9
2. No feasible place on system..... 8
3. Awaiting confidence in reliability..... 7
4. Consideration being or to be given..... 7
5. High fuel cost an incentive, low a deterrent.. 6
6. Awaiting confidence in economic merit..... 4
7. No demand for industrial or district steam... 4
8. Units too large for mercury topping..... 3
9. Equipment too highly specialized for operators 3
10. Advance in steam cycles has outdistanced early attractiveness of mercury cycle..... 3
11. Investment cost too high..... 2
12. Load variable, favorable base load lacking.... 2
13. Plants too small for superposition..... 2
14. Generally skeptical but open-minded..... 2

Straggling comments are that mercury is (1) the best available superposition cycle, (2) that costs of the units have not been sufficiently standardized to permit figuring of commercial jobs or (3) that the assurance about ample supply of mercury is lacking.

GAS TURBINE

A few utility power engineers already see the gas turbine as a challenging potentiality, being attracted by the prospective simplicity of plant design. Several times as many, however, feel that it will require much more time and development to demonstrate its practicability for power systems. When it is perfected, others feel, on the contrary, that there will be a definite place for it, but meanwhile they assert they want to know more about its thermodynamics, economy, limitations, maintenance costs, and operating reliability.

One suggestion is made that the gas turbine might be feasible as drive for boiler auxiliaries. Another is that resort to a heat exchanger might permit delivery of clean air to the gas turbine, thus removing the blade deposit and erosion problem when using the fuels which are commonly burned in steam-generating plants.

Prospective Application Is Limited

Advocates of the gas turbine believe it will before long outride the present limitations and by functioning on a wide range of fuels (including coal) will be economically attractive for any power plant. It operates on a cycle in which high temperature is employed at relatively low pressures and thus may permit utilization of metals that might not feasibly be applied where high temperature is used in conjunction with high pressure. It requires no water either for cooling purposes or for condensing the working gases; it is therefore suitable for localities where adequate water is not available for a steam plant, thereby eliminating an important cost item of steam plants. Maintenance of gas turbine blading is still a dubious matter, but there is hopefulness that, at an early stage, it should prove less troublesome than maintenance of internal combustion engines.

Thermal efficiencies of 30 percent are considered in conjunction with 1,200 F. inert temperature. In order for the gas turbine to be of interest for central station use, it is felt that it probably will be necessary to provide a unit based on pulverized fuel; experiments along these lines are said to be promising. The appreciable difference in price between coal and oil, as well as the possible future scarcity of the latter, is viewed as an incentive for the acceleration of such a program.

Because of the limited heat release of pulverized coal as compared with liquid fuels it is apparent that applications will be confined to stationary land plants where space and weight are of less significance than in mobile plants until higher heat release apparatus can be developed.

Attitude Is Watchful Waiting

On the watchful waiting side are those who see no early justification on their systems, often because price of the required fuel is not competitive with the coal of the area. Strongly reticent are those who believe that appeal of the gas turbine will await the development of metals that will endure the higher temperatures at which it attains superior efficiency, reduced cost and enhanced net over compressor consumption.

SUPERPOSITION

Superposition of low and moderate pressure turbines with higher-pressure, back-pressure units is destined not to be an important factor in post-war expansion of generating capacity. Several instances remain where superposition is deemed feasible and there is some residual disposition to accord competitive consideration to it, but, by and large, the feeling is that the feasible sites have already been pretty well cultivated. Disputing this temper is a more limited belief that superposition may even have been overdone in the last decade.

Interest Is Limited

Only seven companies cited instances where topping is practicable on their systems; further, there is a group twice as large embracing those who are reasonably favorable or at least open-minded, even if skeptical, about the merits of topping for their plants. These constitute the support for future superposition. At the other extreme is a limited group which just does not see superposition as a general economic tool.

Somewhat psychological influences are cited as a

factor in the wave of superposition which marked the pre-war period. When expansion is slow, as it was in the middle of the depression, more thorough attention is paid to operating and investment economies and this led to superposition as a potential tool. When expansion is rapid the easiest, quickest and lowest-first-cost method is adopted with less regard for over-all fuel economy; under these conditions the tendency is to engage in condensing units following well-tried cycles.

Pros and Cons of Superposition

The pros and cons of superposition as a post-war activity embrace the following factors:

1. *Load Increase*—Increase in load may justify superposition by the approach made to base loading.

2. *Load Factor Improvement*—"Superposition? Yes, if the night load is better," is a frequent attitude. Relatively poor load factor is an adverse factor if it necessitates still worse load factor on some stations in an area to support the base loading which superposition requires. In fact, however, any sizable increase in peaks would start a hunt for cheap capacity increments, and this is felt by some an attribute of superposition. Others are equally firm in calling superposition relatively expensive on an over-all basis.

3. *Low-Grade Coal*—Coal with high sulphur, high content of ash of low-fusion temperature is adverse to superposition because it sets a practical temperature limit below that conducive to effective superposition. Cheap coal thwarts superposition on an economy basis.

4. *Small Plants*—Small plants and small systems are viewed as not feasible for superposition. Small, relatively inefficient plants can, however, be retained for peaking if base-loading at other points justifies superposition there.

5. *Age of Low-Pressure Capacity*—There seems to be a definite feeling that superposition may have been overdone in places where the age of the superposed equipment was such that it can hardly survive economically for the life of the superposing turbine. It appears that too little attention may have been given this point. In its stead is rising a disposition to scrap the obsolete equipment and start afresh with condensing turbines and full capacity boilers.

6. *Previous superposition* is a deterrent to further superposition because it may well have absorbed the feasible potentialities.

7. *Flexibility in Operation*—"Too many eggs in one basket" characterizes a hesitancy to engage further in superposition because it limits the flexibility of the plant and system operators in achieving economy with fluctuating load.

8. *Condensing Water*—Insufficiency of condensing water is cited as one item of justification for superposition because it affords opportunity to get more kilowatt-hours out of each pound of steam by upping temperature and pressure.

9. *Present Pressures*—Topping of 200-250-psi. plants is viewed as much more attractive than for 350-400 psi., even for 450-600. The reason given is, quite naturally, that the art is still tied to a top temperature of about 950 F. and for superposition of 450-600 psi. the values would be about 1,300 psi. (or higher) and 1,000 F. Nevertheless thought is being given in spots to 1,800 psi. over 600 psi. where the latter has reasonable life and serious consideration given to topping within the 450-600 psi. bracket. Still others found only slight advantage in topping the lower pressures as against a condensing unit of comparable limits. Further topping of 450-600-psi. units would tend to make obsolete more boilers and turbines than in the case of older 200-300 psi.

An Alternative to Topping

As an alternative to topping at 1,475 psi. and 900 F. there is a preference for a straight-through condensing unit with high extraction to a low-pressure header; this would afford all the advantages of a superposed unit along with the benefits of a straight-through condensing unit when additional extraction steam is not required for the low-pressure plant.

INTERNAL COMBUSTION ENGINES

System conditions where application of internal combustion engines is considered mildly or strongly favorable count up to half as many situations as those where circumstances are deemed partly or wholly adverse. In a few instances the favorable low cost of appropriate fuel makes their use feasible for either base load, standby or peak-load duty. Under less favorable circumstances consideration is and will be given for standby use in low-load areas reliant wholly on extended transmission lines. Almost as many situations exist where condensing water is or may be scant, where peak load equipment of low first cost is desirable or where the high salvage value and relative movability of internal combustion engines will com-

mand consideration. The extensive familiarity acquired by men in the armed services is cited as an inducement toward favorable consideration of internal combustion engines as supplements to steam and hydro systems.

Influence of Rating and Fuel

Dominant among the unfavorable attitudes toward adoption of internal combustion engines is the fact that the available units are manifestly too small for systems requiring relatively large units in large plants in order to serve concentrated load areas economically. In numerous areas the cost of appropriate fuel is not competitively low enough. Without citing either factor, several utilities merely consider that there is no appropriate place on their systems. As many more deem the unit cost high, the reliability insufficiently established and maintenance high because of the multiplicity of reciprocating parts. Short life, noisiness and poor economy at light load a detriment to use as spinning reserve are other adverse characteristics cited. The requirements of an operating organization different and distinct from that developed for steam plants is another mentioned drawback. Among the partly favorable group are some, however, who would consider such units as quick-starting, automatic plants for use in remote areas.

On the whole, there appears to be a moderate degree of increased willingness to give consideration to internal combustion engines as adjuncts of systems primarily committed to steam-generated power.

FORCED CIRCULATION BOILER

Manifestly more experience and development will have to accumulate before forced-circulation boilers will win extensive consideration for utility power plants. Justification for adoption on many systems is reported lacking; reasons given are that information about them is much too incomplete, that they are still in the experimental stage, that the prospective benefits do not offset the prospective cost and complexities, that cheap fuel precludes the use of steam pressures conducive to forced circulation design and, in general, that it offers little advantage over natural circulation for the steam pressures most commonly employed. Other adverse arguments, somewhat scattering, are these: drop in price of steel will vitiate much of the economy in metal of the forced-circulation boiler, and also that the smaller tubes permissible accentuate the risk of corrosion. One isolated objection is that forced-circulation equipment departs from the familiar technique of natural circulation.

Skepticism marks the attitude of some engineers regarding superiority in operating economy, cost of maintenance and operating reliability.

Proof of Practicability Awaited

A respectably sized group, however, believe forced circulation will have a definite place in the economy of future plants. Watchfully awaiting results of current developments are those who report they would consider on the basis of over-all competitive merit, like the promise of lower investment cost in the boiler, *per se*, or would surely give consideration for any situation where space (particularly headroom) proved to be limited. A suggestion is offered that forced circulation might feasibly be a corrective for poor circulation in existing boilers operating at lower pressures than would be considered peculiarly competitive for resort to the forced circulation type of boiler.

MOBILE POWER PLANTS

Mobile power plants along the pattern of the rail-car and barge types developed for wartime use appear to have no justifiable future place on two-thirds of the power systems. Reasons given are that well-established, well-tied areas do not need them for emergency and that community stability dictates a provision of permanent, fixed generation facilities for normal periods. Also cited are the insufficiency of capacity in the rail-car unit and the impracticability of using the barge form on rivers that freeze or even those that do not freeze but afford limited water for condensing. Floods also hamper delivering the fuel, create problems in accessibility of employees and cause troubles from driftwood. Nor does

the negative group believe these units are economically practicable for anything but dire emergency, and then only if rentable on short notice.

Limited Applicability Envisioned

A third of the power utilities are more tolerant of potentialities of floating or rolling power generating units. Among the suggested possibilities of practicable use are the following: for seasonal peaks when these do not occur simultaneously on systems in reasonably close proximity, as stop-gap source while erecting permanent additions of capacity, for protecting service from long lines, use of rail-diesel unit while taking lines out for maintenance work, and to supply power for dubiously permanent loads in underdeveloped areas. More common than all these moderately favorable contingencies is the receptiveness for use in prolonged and unforeseen emergencies. Smaller units (75 to 125 kw.) are looked upon with favor, in an isolated instance, to handle the loads of small, scattered communities during local interruptions while line repairs are made.

On the whole, however, the industry is either lukewarm or wholly negative about the feasibility of finding a permanent use for the floating or rolling units of wartime development.

OUTDOOR PLANTS

Half the utilities state that the climate of their territory is too rigorous to warrant consideration of an "outdoor" power plant. Both the operating personnel and equipment must be protected against the weather and only fans and dust collectors can be placed external to the inclosing structure. Any adaptation of the full-outdoor design is viewed as occasioning delays in maintenance and increase in operating cost, particularly during emergencies; this is the view of another quarter of the industry.

Favorable Attitude Where Climate Is Conducive

Remaining are another quarter which does not have an adverse climate and either favor an outdoor design or, at least, consider it feasible. Semi-outdoor layouts are considered by this group to have proved successful. Even where the climate is somewhat adverse the prospect of paring costs of power plant structures is attractive. Countering this favorable viewpoint is, however, one to the effect that labor costs of factory-built equipments for outdoor installation may rise to match the high rates for building construction labor and detract from the apparent savings derived from an outdoor design. Strongly on the positive side is a favorably situated utility which doubts if it will ever build another plant that does not capitalize on the economy offered by outdoor design.

Abetting this stand is a utility, in much less favorable territory, which has "every reason to believe that the outdoor plant should become a reality in all climates."

A West Coast Operating Engineer agrees:

"If we expect to keep our costs down after the war, we must take full advantage of standardized lines of equipment offered by manufacturers at lower prices."

THIS is one of the many encouraging reactions to General Electric's recent proposal to extend the use of standard designs to the heavy-apparatus field. It helps bear out our belief that the most direct way to lower tomorrow's capital investment will be found in the economies of repetitive manufacture — of power transformers, switchgear, and other heavy apparatus.

As an example, General Electric found it possible to lower prices 35 per cent on factory-assembled switchgear, as it replaced more and more "one-of-a-kind" switchgear units. And in our war production of other heavy apparatus, equally important cost economies have come out of repetitive manufacture.

Of course, the possibilities for future savings cannot be realized by the individual effort of any manufacturer — or even by the manufacturing industry as a whole. Rather, builders and users must work together, each accepting minor limitations on individual preference for the sake of major gains over-all.

We believe that both branches of the electrical industry are ready to take this step. If you confirm this opinion, won't you, too, tell us? *General Electric Company, Schenectady, N. Y.*

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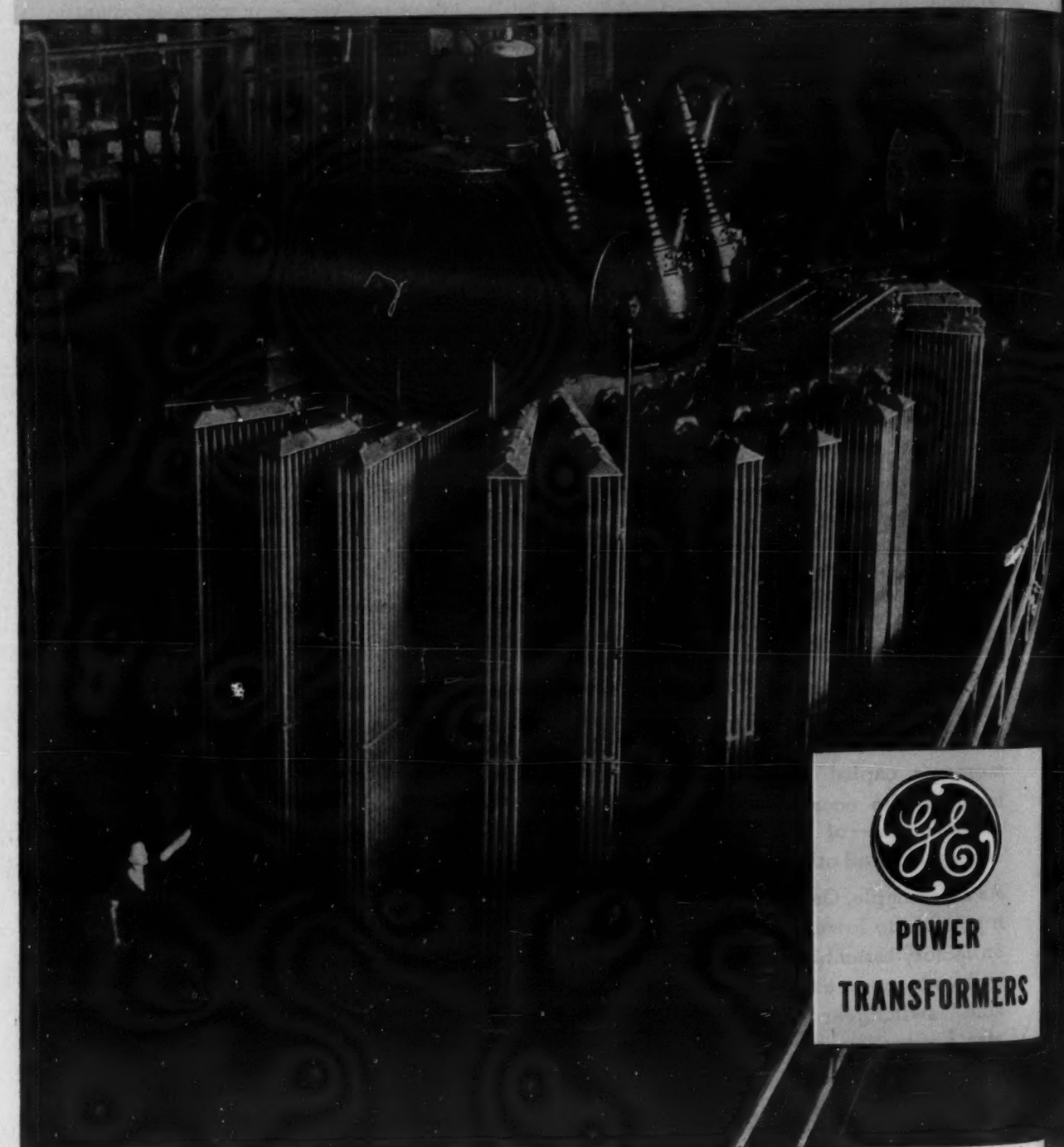

THIS mammoth, self-cooled G-E power transformer (75,000 kva, three-phase, 132,000 volts), now supplying power to a highly important war industry, is the *lightest* and *smallest* transformer of this rating ever built in this country.

IMPROVEMENTS in basic materials, and their scientific application, made this engineering achievement possible. If this unit were to be designed today, it would be *even smaller.*

Core-steel development is only one of the many phases of transformer research and engineering. But it serves to illustrate how the use of improved materials throughout a transformer enables us to build you smaller, lighter, less costly transformers, with an *over-all* improvement in operating characteristics.

The two developments that stand out in the history of transformer cores were both made by General Electric:

FIRST, the production in 1903 of the first silicon steel made in this country.

SECOND, the application of high-permeability silicon steel in the form of cold-rolled strip, first marketed in the Spirakore* distribution transformer in 1937, and later used in many power transformers—in fact in every type of G-E transformer *where it can be used to advantage.*

The steel made famous by Spirakore has already been greatly improved. Today's research with the metallurgist's crucible, and advanced techniques in processing, indicate *still better* core steel for the G-E transformers of tomorrow. *General Electric Company, Schenectady, N. Y.*

*Reg. U.S. Pat. Off.

OW IMPROVEMENTS IN STEEL HAVE REDUCED THE POUNDS REQUIRED PER KVA

903 — using "standard iron" of the best grade then available, core steel per kva weighed nearly seven times what it does today.

905 — general use of hot-rolled silicon steel, first produced in this country in G-E furnaces in 1903, decreased the core steel per kva by nearly one half.

920 — the steady improvements in quality, resulting from continued metallurgical research, had again brought down the steel requirements.

937 — cold-rolled, oriented strip steel, introduced in G-E Spirakore transformers, cut basic pounds per kva still further.

DAY, 943 — with modern steels, either hot-rolled or cold-rolled, *scientifically applied,* G-E transformers use less steel per kva than ever before.

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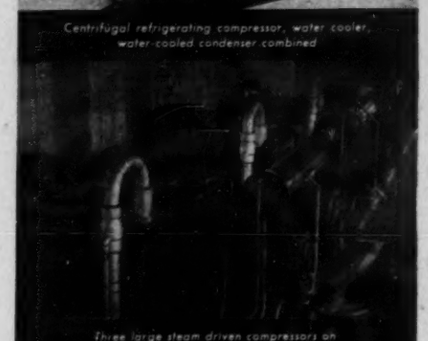
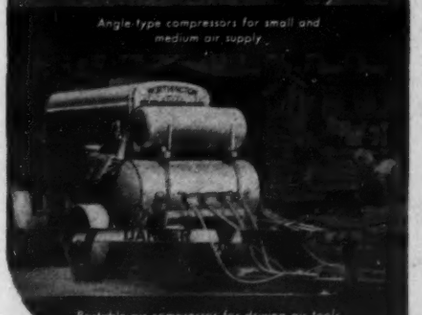


Three large steam driven compressors on manufactured gas distribution

Angle-type compressors for small and medium air supply



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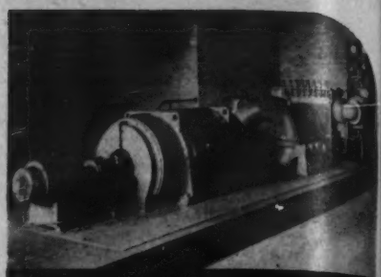
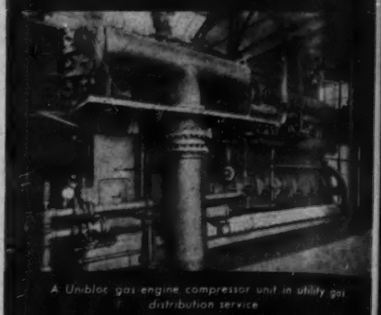
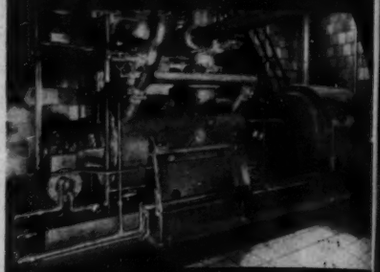


Condensing type steam turbo-generator unit

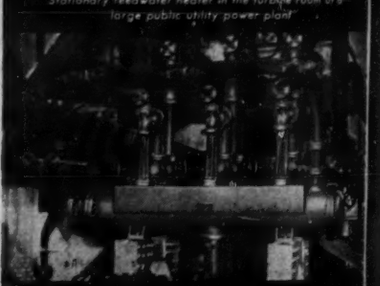


A Unibloc gas engine compressor unit in utility gas distribution service

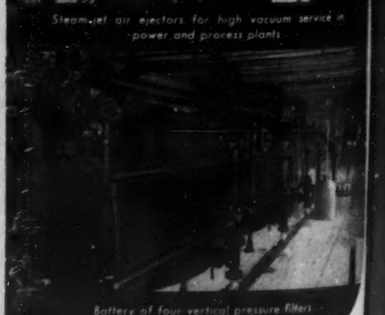


High pressure centrifugal boiler feed pump in a large power plant

Stationary feedwater heater in the turbine room of a large public utility power plant



Steam-jet air ejectors for high vacuum service in power and process plants



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the requirements of
operating conditi
readily responds to
and heavy demand
steam, and delive
steam at relatively
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water having a
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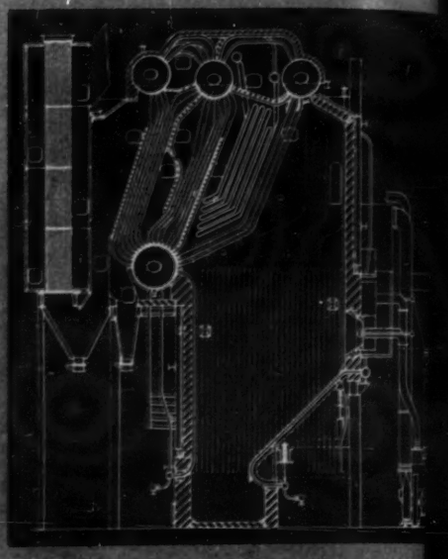
fired with any fuel.



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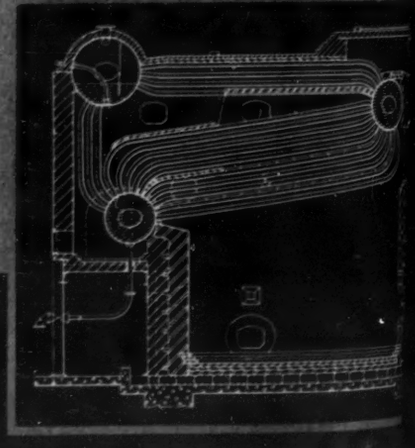

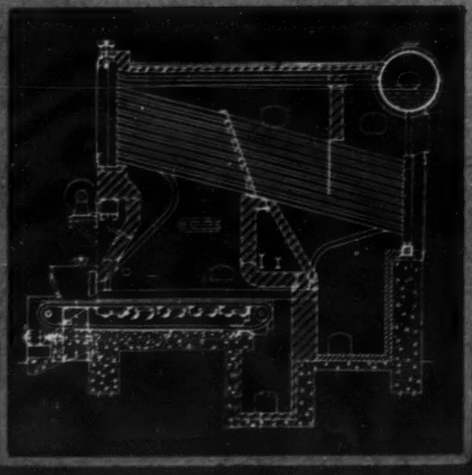

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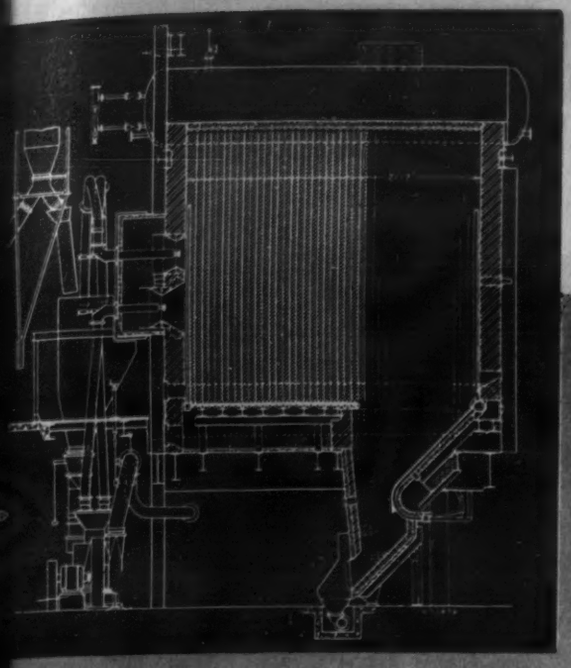
CROSS-DRUM BOILER

This unit is widely used in small and medium-size power plants where refractory furnaces are suitable. It provides the advantages of the straight-tube, sectional-header construction used in B&W Cross-Drum Boilers designed for larger capacities.



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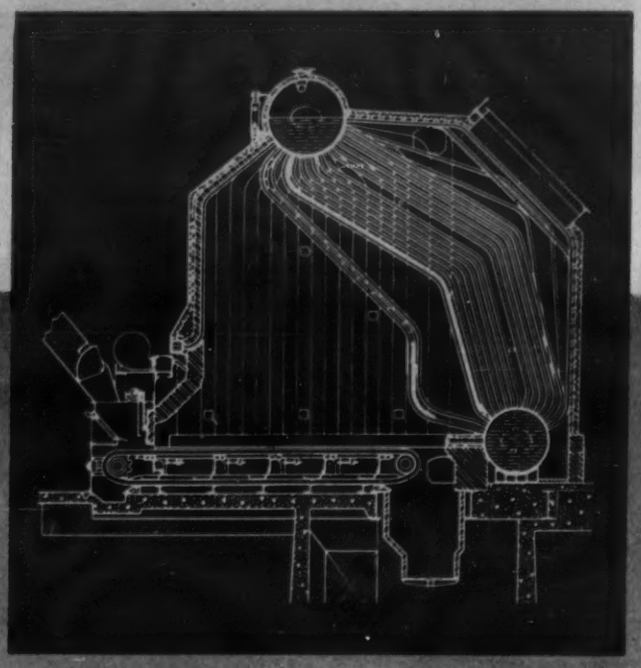
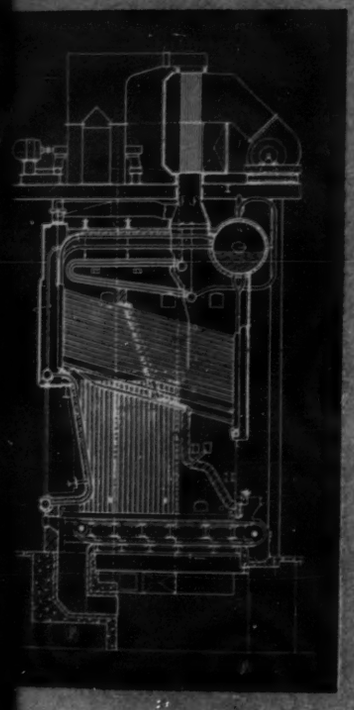


B&W INTEGRAL-FURNACE BOILER (CLASSES 9, 12, & 15)

This Integral-Furnace Boiler is available for firing with stokers or with oil, and in sizes ranging from 1353 to 6506 sq. ft. of heating surface. Having a water-cooled furnace of special design, this boiler provides the dependability of central-station boilers, with efficient and smokeless combustion.

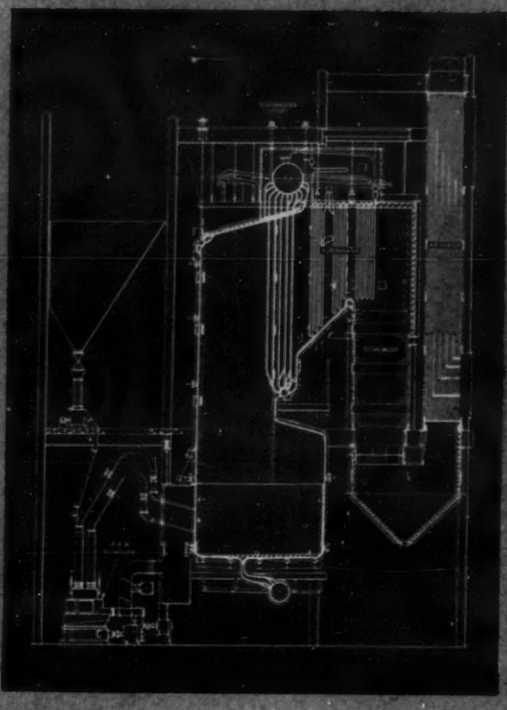


B&W CROSS-DRUM BOILER

This straight-tube sectional-header boiler is noted for its dependability, long life, and ability to deliver dry steam at high ratings. Can be readily inspected and cleaned.

CENTRAL-STATION BOILERS

High-duty boilers for central-station service are available in several basic designs to meet the requirements of individual stations. The Radiant boiler unit illustrated is typical of some of the units now operating at high rates in utility plants.



G-261F

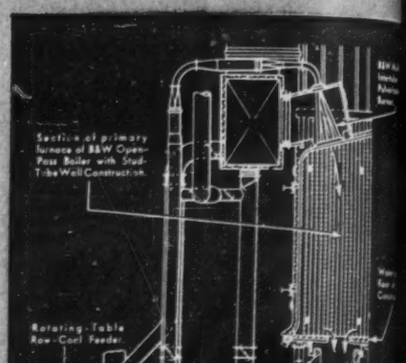
B&W Component EQUIPMENT

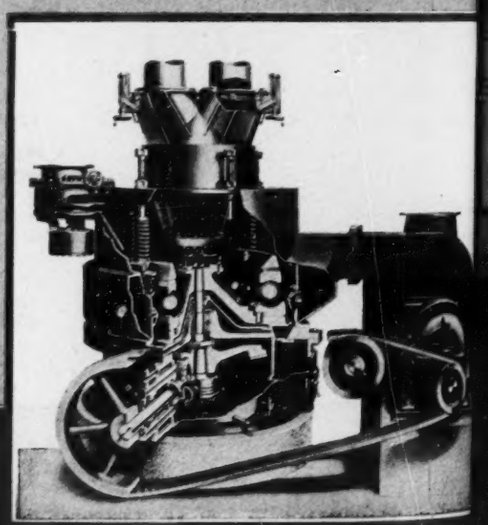
makes maximum use of available men and materials

B&W DIRECT-FIRING PULVERIZED-COAL SYS

B&W direct-firing pulv coal system has adva in ease of operation, ability and upkeep make it economical for as well as large boile is readily applied to all boilers for conversion to firing.

It is definitely certain that a chain is no stronger than its weakest link. Similarly, a steam-power boiler unit, composed as it is of elements additional to the boiler proper, must be equally as reliable from fuel entrance to flue-gas outlet. Component equipment of B&W boiler units, shown on these pages, is engineered and fabricated for complete co-ordination of operational functions to meet specific requirements exactly and to assure to power plant operators the attainment of design efficiency. They also provide the dependability and availability for service that are necessary to meet today's handicap of shortages in materials for replacement and in manpower for operation and maintenance.

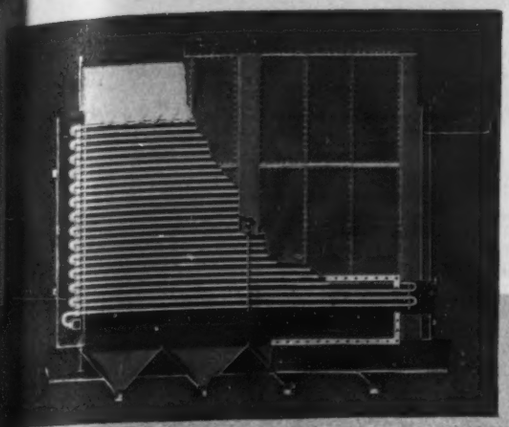

Section of primary furnace of B&W Open-Pass Boiler with Stud-Tube Wall Construction
Rotating-Table Raw-Coal Feeder
B&W Type E Pulverizer



B&W PULVERIZERS

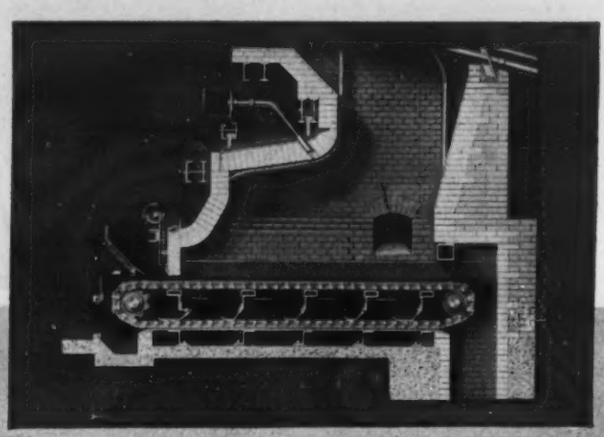
The simplicity and sturdiness of B&W ball-bearing type pulverizers assure high availability with low maintenance in direct-firing pulverized-coal systems. They provide consistently high fineness and respond quickly to changes in load with automatic control of raw-coal feed.

★ BUY MORE WAR BONDS! ★



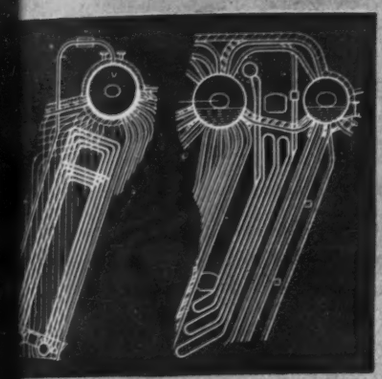
ECONOMIZERS

&W Economizers effect appreciable savings in fuel and an be built to meet the size and pressure requirements f any installation. The Return-Bend Economizer shown an be easily cleaned, and pressure parts may be in-pected externally while in service.



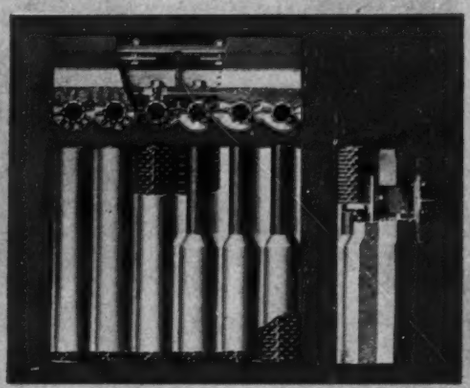
CHAIN-GRATE STOKERS

Babcock & Wilcox Chain-Grate Stokers are widely used with free-burning bituminous coal, anthracite, lignite, and coke breeze. They can be furnished for natural, induced, or forced draft, depending upon operating conditions.



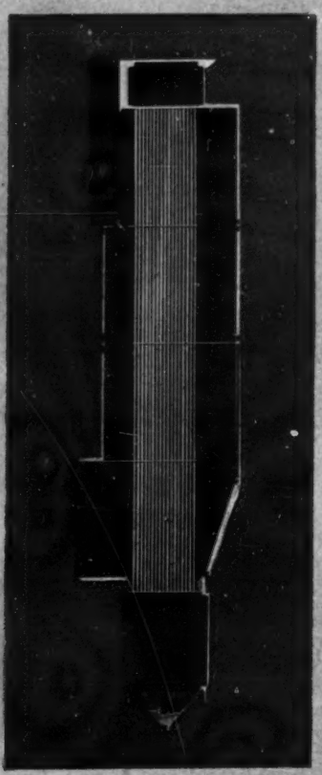
SUPERHEATERS

Superheaters are properly designed and cated, with respect to steam and gas flow, action efficiently with boilers designed and by B&W. Available in both draining and raining types as shown.



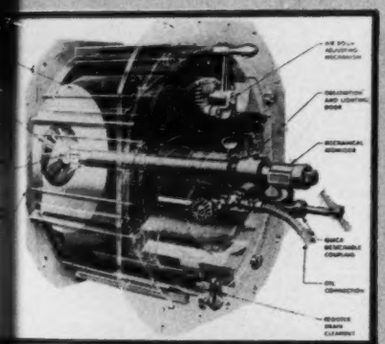
WATER-COOLED FURNACE CONSTRUCTIONS

B&W Water-Cooled Furnace Constructions are extensively applied for partial or complete water cooling of furnaces of all sizes, shapes, and forms, and with all fuels and combustion methods. Studded-tube type of construction is shown.



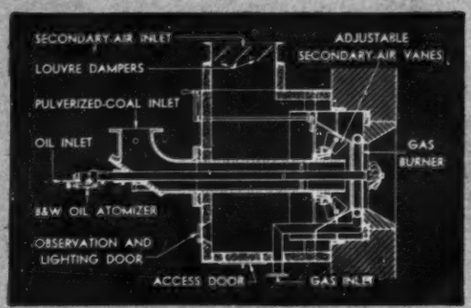
AIR HEATERS

B&W Tubular Air Heaters are inherently tight and efficient, and are easy to keep clean. Available in multi-pass gas flow type, as shown, or longitudinal gas-flow type, and in sizes to meet the requirements of any boiler installation.



OIL BURNERS

Burners effect rapid and complete com-at all rates of fuel feed, using mechanical, steam-mechanical atomizers, depending and operating conditions. Available in a heat liberating capacities that meet all ents.



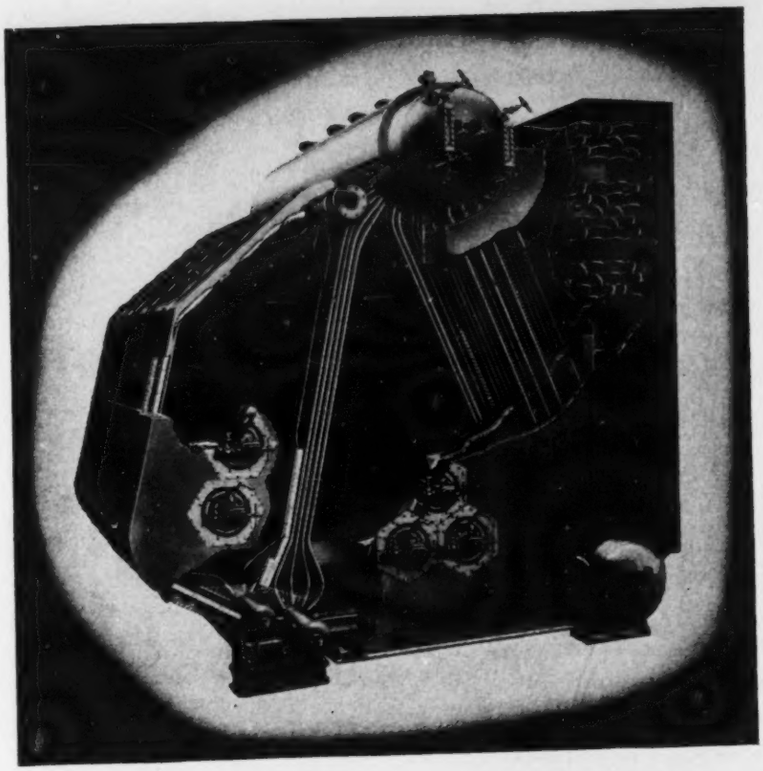
MULTIFUEL CIRCULAR BURNER

Pulverized solid fuels, oil, and gas are burned singly or in any combination with this burner. It provides a single means of efficiently burning a wide range of fuels, permitting advantage to be taken of variations in the availability and market prices of these fuels.

THE BABCOCK & WILCOX CO., 85 LIBERTY STREET, NEW YORK 6, N. Y.

BABCOCK & WILCOX

BLAZING the



MARINE SEPARATELY-FIRED SUPERHEATER STEAM GENERATOR

● This steaming unit offers advantages un- obtainable with usual standard construction:

1. Precision control of final steam tem- perature independent of rate of steam generation.

2. Saturated steam can be taken di- rectly from steam drum without an desuperheaters.

3. Any combination and quantity o superheated and saturated steam as re quired to temperatures of 850°F.

4. All superheater surfaces exposed t furnace, hence easy to clean.

5. High overall efficiency, light i weight, flexible in service, low in mai tenance, prodigious in power.

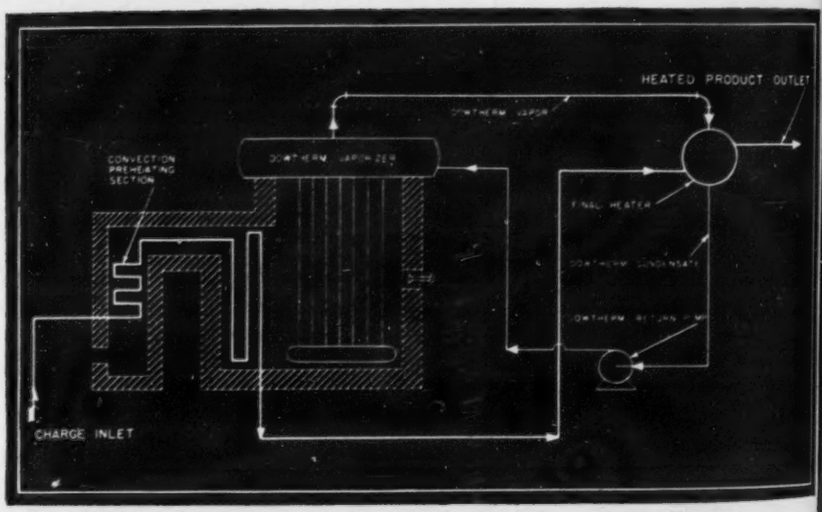
OIL HEATING WITH DOWTHERM

PROBLEM:

Heating a sensitive oil to 650 deg. F. Danger of overheating makes use of direct firing impractical.

SOLUTION:

Oil is first preheated to 550 deg. F. in convection and semi-radiant sections of a combination direct fired oil heater and Dowtherm Vaporizer. In the final stage the oil is heated from 550 deg. F. to 650 deg. F. in a shell and tube type preheater by condensing Dowtherm Vapor generated by radiant tubes in the furnace of the direct fired heater. The system eliminates the danger of localized overheating and effects the close temperature control on which the success of the process depends.

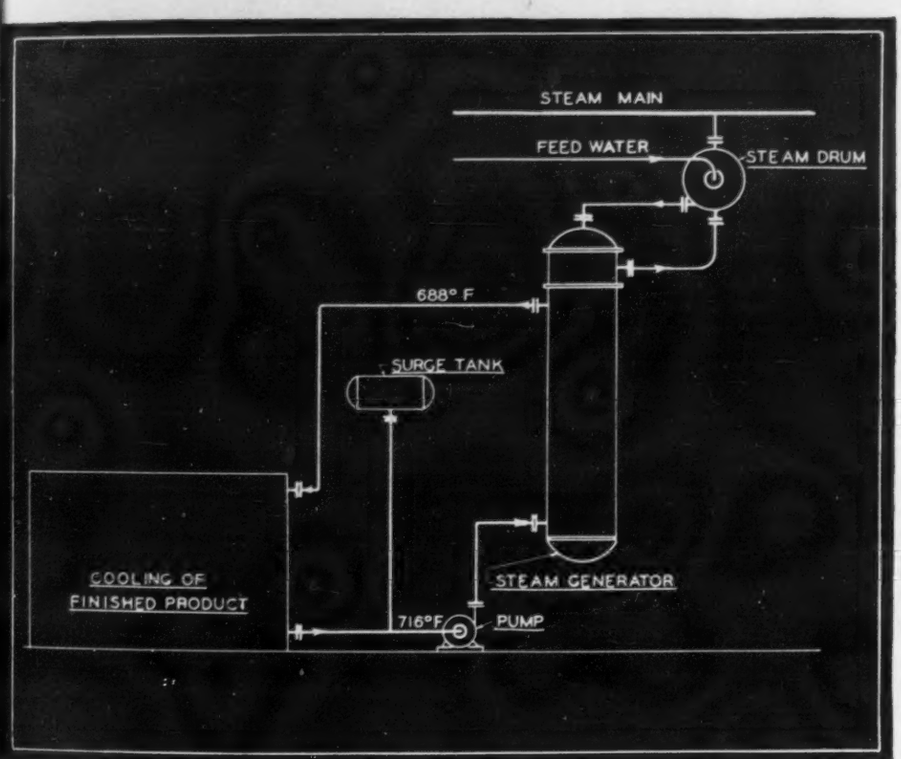


FW FOSTER

ENGINEERING TRAIL

The contribution of progressive engineering is its ability to successfully solve difficult and unusual problems. Foster Wheeler concentrates on original engineering research, both as to improving existing designs and exploring the possibilities of new developments. Three recent and prominent examples of such progressive engineering are: The separately-fired superheater marine steam generator; the industrial application of Dowtherm for the conversion of waste heat into power and for the heating of sensitive oils.

FOSTER WHEELER CORPORATION **165 BROADWAY, NEW YORK 6, N. Y.**



Dowtherm Converts Waste Heat to Power

● This system utilizes the high temperature characteristics of Dowtherm to cool the product while generating steam for power. Dowtherm liquid leaves the cooling chamber at 716°F, enters a steam generator and produces 14,400 lb. of steam per hour at 600 psi. This heat recovery system operates at less than 150 lbs. gage pressure (the boiling point of Dowtherm at 135 lbs. gage pressure is 750 deg. F.) thus eliminating need of a costly high pressure installation or use of a less suitable or more expensive heating transfer medium. If a more constant temperature control is required in the chamber utilizing the recovered heat, Dowtherm in vapor form would be substituted for the liquid.

WHEELER FW

Announcing

NEW

BUYING DATA

THAT REDUCES MOTOR AND CONTROL SELECTION AND ORDERING TIME 1/2

Westinghouse takes pride in introducing new, simplified Buying Data, which enables you to select and purchase the proper motor and control for your job—in one-half the time!

Data, as presented, is striking in its newness. It's easier to read, easier to understand, and easier to use than any offered previously by any manufacturer.

To fit widely varying requirements, this radically new Buying Data is available in two forms:

- **Bound books** are suitable for use of the majority of motor and control buyers. They contain prices (correct at time of issue and satisfactory for estimating purposes throughout the books' life), dimensions, application data and descriptions. They include the following:

  "Motor Buying Data" covers popular types and ratings of Motors (up to 100 hp), Gearmotors and M-G Sets.

  "Control Buying Data" lists a wide variety of controllers and accessories for direct current, single-phase, squirrel-cage and wound rotor motors.

- **Motor and Control Loose-Leaf Book.** This is for the use of large-scale purchasers and is "tailored" to meet the needs of the individual buyer. Pricing data is always kept up to date by the issuance of new price supplements.

SIMPLIFIED

FOR QUICKER SELECTION . . . EASIER ORDERING . . . QUICKER DELIVERY

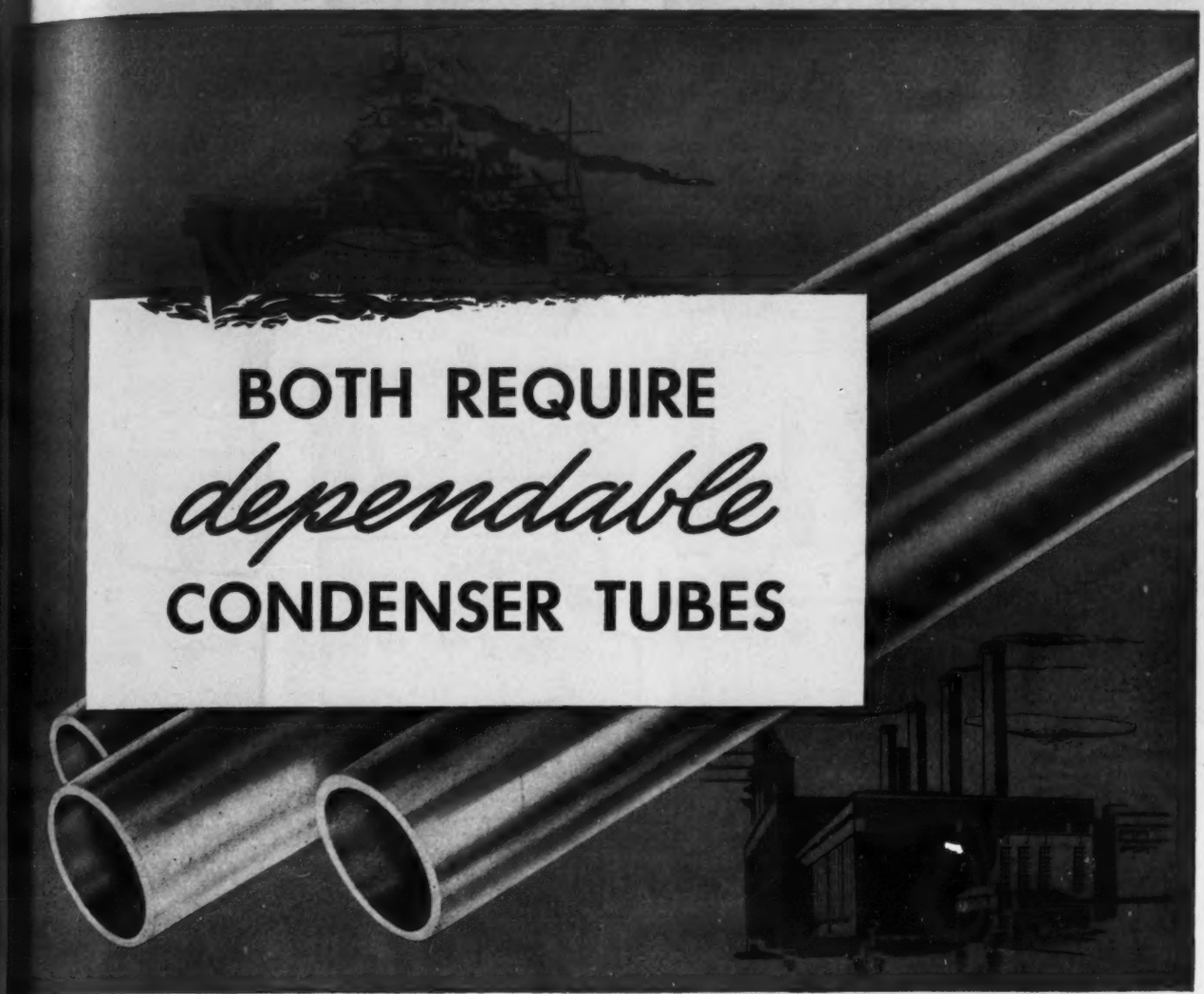
HERE'S HOW TO GET THIS NEW BUYING DATA

If you are a buyer of Motors and Control, chances are you have already received this new data by mail.

However, if you have not received your copy, write, wire or phone your nearest Westinghouse district office (distribution will be made through district offices only—no mailings from Westinghouse Headquarters at East Pittsburgh). Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

J-90485

Westinghouse PLANTS IN 25 CITIES... OFFICES EVERYWHERE *Motors and Control*



BOTH REQUIRE *dependable* CONDENSER TUBES

An unprecedented amount of power is needed by the nation's plants and factories to meet production quotas. Dependable condenser tubes play an important part in maintaining uninterrupted production of power.

The American Brass Company, with its expanded facilities and wide experience, is an important source of supply for condenser tubes and tube sheets. For stationary condensers on tidewater, the most serviceable tube alloys are Ambraloy (Aluminum Brass) 927 and Arsenical Admiralty 439. For inland stations using fresh water, especially if it is alkaline, deoxidized Arsenical Copper 108 has given superior service under the most severe conditions.

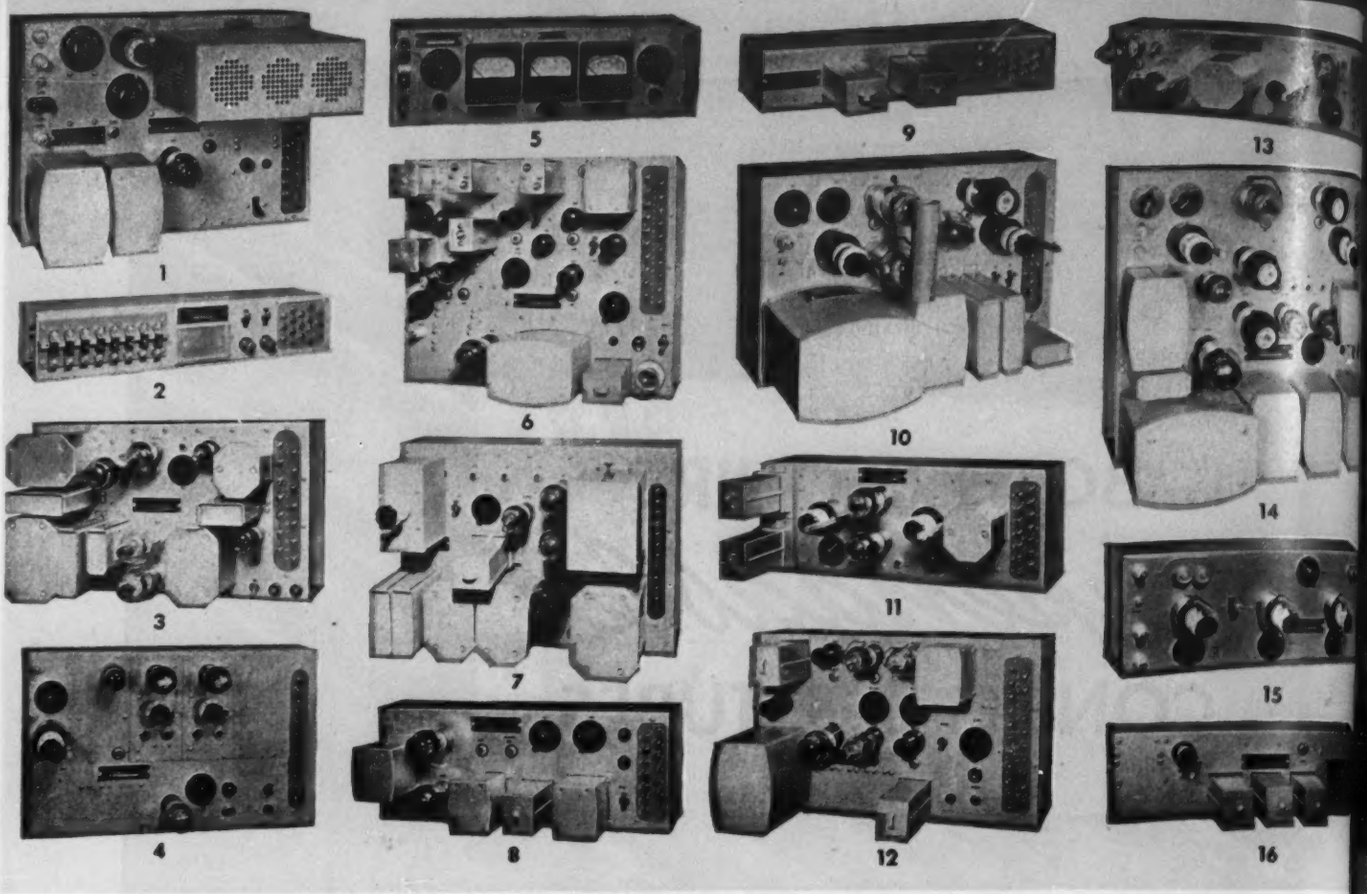
The technical and practical knowledge, accumulated during a century and more of experience in the manufacture of copper and brass products, provides our Technical Department with a broad background in the study of metal problems. Anaconda Engineers are always available to assist in selecting the most satisfactory and economical tube for specific condenser operating conditions. 4370A

BUY ALL THE WAR BONDS YOU CAN AFFORD

ANACONDA
From mine to consumer

Anaconda Condenser Tubes

THE AMERICAN BRASS COMPANY—General Offices: Waterbury 88, Connecticut
Subsidiary of Anaconda Copper Mining Co. • In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.



ANY combination of carrier

MAY BE MADE FROM 77 DIFFERENT G-E STANDARD "PANEL UNITS"

THESE standardized "panel units"—designed and co-ordinated against a background of more than 20 years' practical experience—are General Electric's answer to any carrier-current problem.

Compact, efficient, and uniform in high quality and engineering, each combines electrically and mechanically with one or more of the other 77 units—and with standard cabinets of convenient size for indoor or outdoor installation.

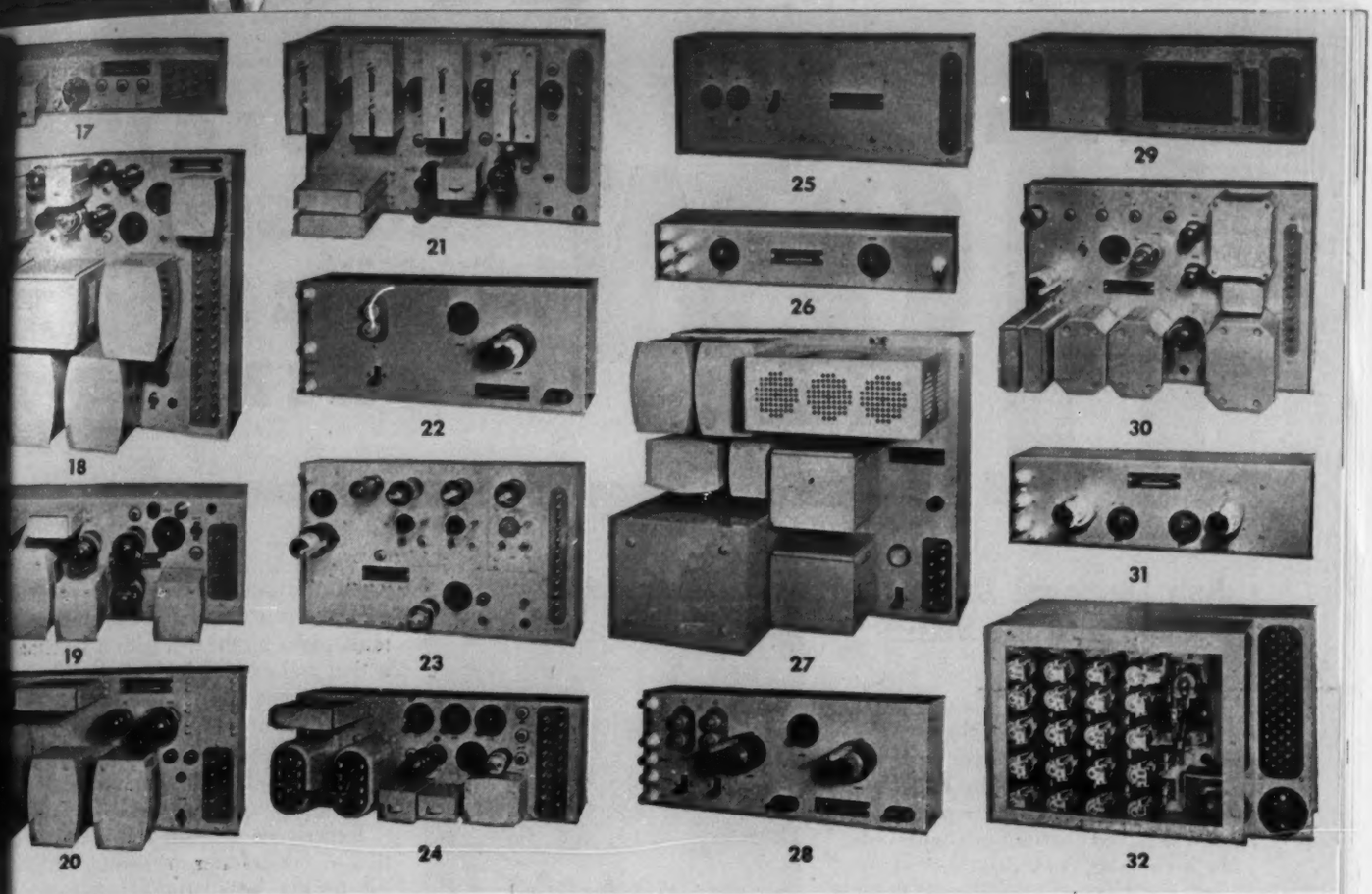
No other carrier equipment offers such flexibility in design or function. Whether your requirements are met by an assembly the size of a suitcase or the 24-unit equipment at the right, future needs for more or different carrier-current services will be accommodated easily and economically.

Major carrier functions include pilot relaying, transferred tripping, supervisory control, telephony, telemetering and automatic load control.

General Electric engineers will be glad to discuss your needs, and to help you select the most suitable combination. Write to *Electronics Department, General Electric, Schenectady, New York.*

• ***Tune in "The World Today" every evening except Sunday at 6:45 E.W.T. over CBS. On Sunday listen to the G-E "All Girl Orchestra" at 10 P.M. E.W.T. over NBC.***

GENERAL ELECTRIC

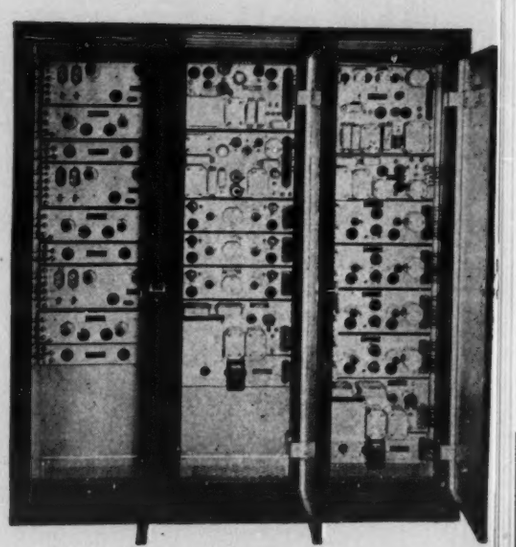


ier rrent services you need . . .

GENERAL ELECTRIC CARRIER-CURRENT *PANEL UNITS*

1. Carrier-frequency amplifier.
2. Fuse-alarm unit.
3. Telephone modulator.
4. Telemetering transmitter.
5. Meter unit.
6. Superheterodyne receiver.
7. Supervisory control transmitter.
8. Relaying modulator.
9. Simplex telephone auxiliary.
10. Transmitter, 50-150 kc.
11. Audio filter and relay.
12. Single-frequency duplex telephone control.
13. Audio oscillator.
14. Transmitter-modulator, 50-150 kc.
15. Two-frequency line tuning.
16. Simplex telephone auxiliary, 800-cycle, ringing.
17. Single-frequency duplex telephone code ring.
18. Power supply for selective ringing.
19. Audio amplifier.
20. Power supply for audio units.
21. Telemetering or control receiver.
22. Single-frequency ground-return line-tuning unit.
23. Load-control or supervisory transmitter.
24. Two-frequency duplex telephone control.
25. Input-voltage control.
26. Impedance matching transformer.
27. Power pack for carrier-frequency amplifier.
28. Interphase line-tuning unit.
29. Telephone-line protective-and-jack unit.
30. Telemetering or control transmitter.
31. Double trapping unit.
32. Selective ringing unit.

GENERAL ELECTRIC HAS PLANNED AND BUILT MORE CARRIER-CURRENT EQUIPMENT THAN ALL OTHER MANUFACTURERS COMBINED



CARRIER CURRENT

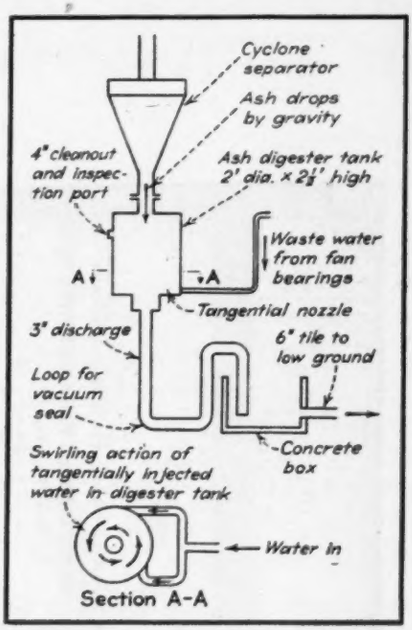
THE NERVE NETWORK OF THE POWER SYSTEM

HOW DESIGN... CONSTRUCT OPERATE MAINTAIN

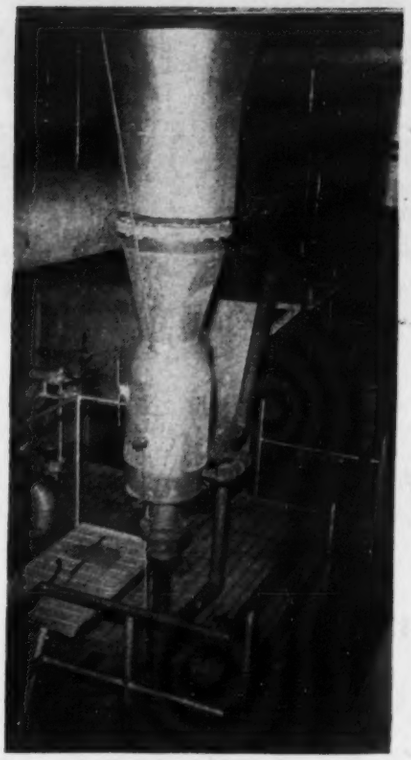
Ash Disposal Done on Continuous Basis

Fly ash from the cyclone precipitator at Ohio River station, Evansville, Ind., instead of being accumulated dry in a storage tank and periodically evacuated by a hydro-jet ejector to a sluice in the plant yard, now is mixed continuously with water in a compact "ash digester," shown, and discharged by gravity to the sluice. Waste cooling water from fan bearings is used for the purpose. Arrangement of the digester is shown in the drawing.

A saving in both material and time has resulted from the use of this system of ash disposal, which has been operating trouble-free for the past seven months. Its use has freed the 10-ft. diameter, 20-ft. tank in which up to 20 tons of dry fly ash was formerly accumulated for periodic disposal. In addition, the time of one man for two hours daily per boiler, required for sluicing away the accumulated ash, has been released. The digester, which operates continuously, requires no supervision.



SCHEMATIC arrangement of ash-disposal system



ASH "DIGESTER" disposes of fly ash from cyclone separator on continuous basis

As shown in the drawing, the digester consists simply of a small tank—actually an old current transformer case—about 2 ft. diameter and 2½ ft. high to which ash is discharged continuously under slight negative pressure by gravity from the cyclone separator. Waste cooling water, introduced through two tangential jets at the base of the digester tank, picks up the ash with a swirling action and carries it through a drain—which has been provided with a loop to maintain negative pressure in the digester tank—to a concrete box in the yard, from which the mixture flows away to waste.

Experience with the initial installation of the digester on one boiler has led to the installation of a second unit on the new boiler being completed at this station.

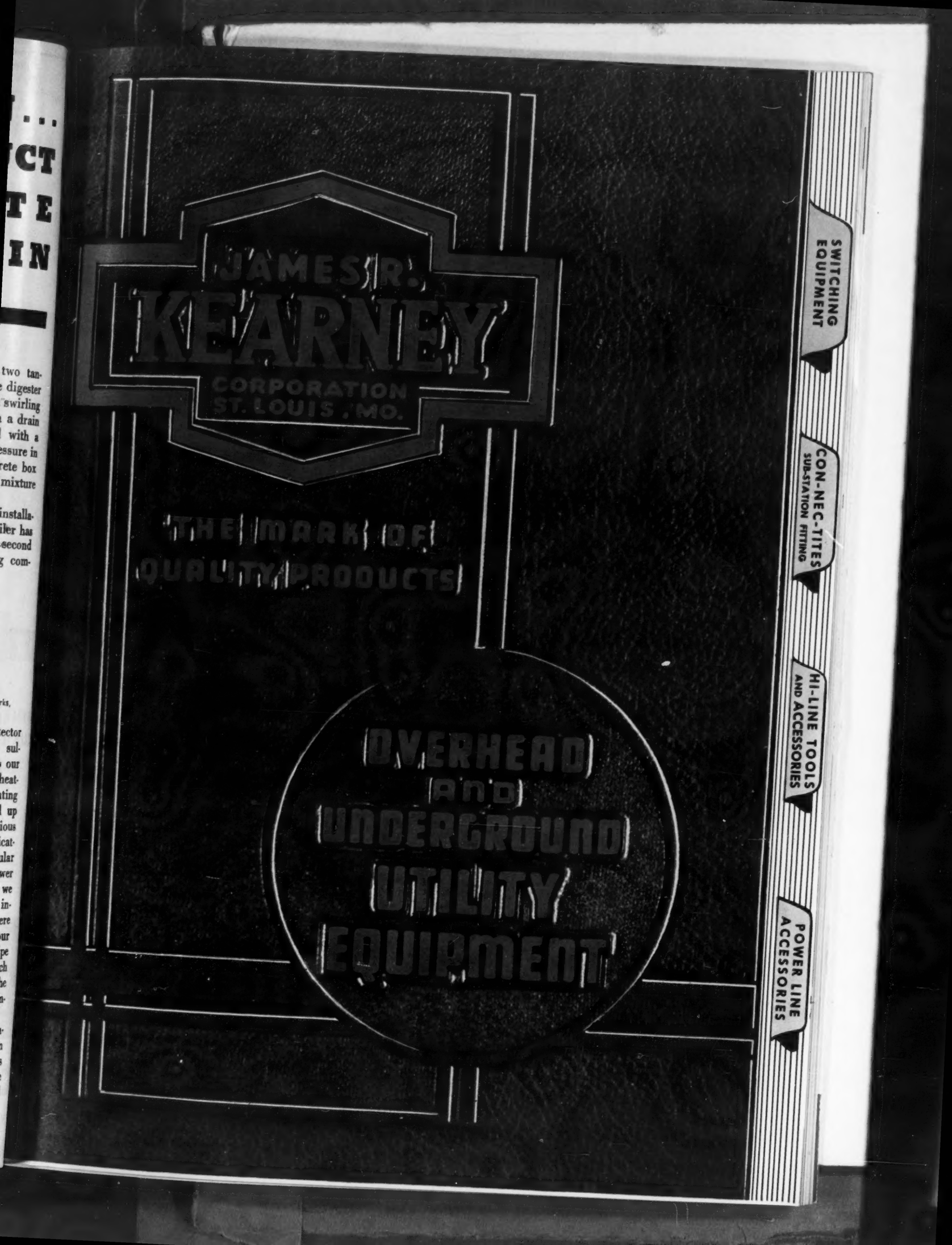
•

Spark Plugs Detect Acid in Condensate

By **WILLIAM LUND**
Chief Electrician, Raritan Copper Works, Perth Amboy, N. J.

We have developed an acid detector to detect copper sulphate and sulphuric acid electrolyte leaks into our steam condensate lines from the heating coils of our electrolyte heating tanks. This condensate is stored up in storage tanks and used for various purposes. At the first alarm, indicating a leaky steam coil, this particular condensate line is run to the sewer or cutout until corrected. Before we had installed this very satisfactory instantaneous acid detector we were continually having trouble with our steam condensate pumps and pipe lines, due to acid corrosion, which would do serious damage before the leak was discovered by routine chemical tests.

Another very satisfactory application for this acid detector has been found on the steam condensate lines from our Swenson evaporator, where electrolyte containing sulphuric acid is boiled down to a strong concentra-

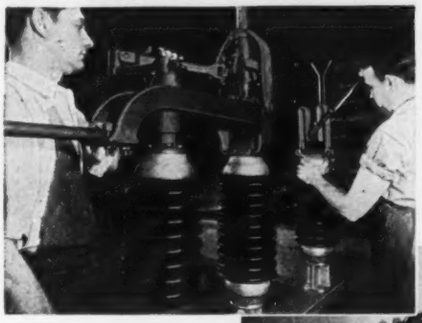

JAMES R.
KEARNEY
CORPORATION
ST. LOUIS, MO.
THE MARK OF
QUALITY PRODUCTS
OVERHEAD
AND
UNDERGROUND
UTILITY
EQUIPMENT
SWITCHING EQUIPMENT
CON-NEC-TITES
SUB-STATION FITTING
HI-LINE TOOLS
AND ACCESSORIES
POWER LINE
ACCESSORIES

SWITCHING EQUIPMENT

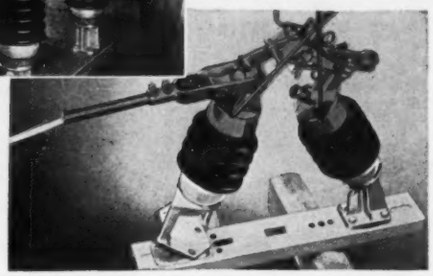
For Maximum Protection and Greater Flexibility of Power Li

GANG OPERATED DISCONNECTS

— Sturdy construction is an essential necessity which has been incorporated into Kearney Gang Operated Disconnect Switches, along with other features such as point pressure contacts and sleet breaking design.



—At left, a modern vertical break Kearney Rotating Insulator Type Gang Operated Disconnect Switch. These sturdy switches are available in voltages from 7500 volts up to 115,000 volts; 400, 600 and 1200 amperes.



— At right, the Kearney Rocker Type Gang Operated Switch that has point pressure contacts and point pressure pantograph that eliminates possibilities of troubles with cable at this point.

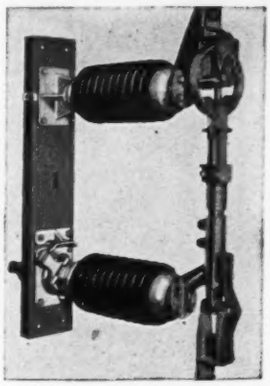
KEARNEY FUSE CUTOUT

Kearney Open Type Fuse Cutouts are available in two type the popular Trip-Out Switches, available in ratings: 100 a 200 amperes, 5000, through 46,000 volts, and the 100 amp 69,000 volt Trip-Out. The widely used, inexpensive Trip-O-Link Fuse Switch is available in ratings: 50, 75 and 100 amperes, 5000 through 69,000 volts. Both types are time-tested, guaranteed products. Point pressure contacts are a design feature of these modern switches.

Illustrated at right is a high voltage 100 ampere Kearney Trip-Out-Fuse Switch, featuring point pressure contacts.

— Kearney Trip-O-Link Fuse Switch such as the 15,000 volt type shown, have fu over values and interrupting capacities in accor ance with N.E.M.A. Specifications SG9-20 cutouts rated 50 amperes.

HORIZONTAL BREAK DISCONNECTS



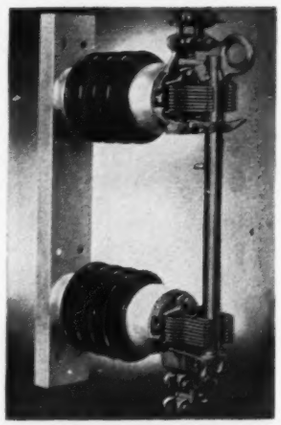
Kearney Wheel Type, Single Break Rotating Insulator Switches are in ratings up to 115,000 volts.

— The Switch shown at left is particularly recommended for its sleet-breaking performance. Opening and closing of the blades assure positive wiping action. The contact wheel revolves slightly with each operation and provides a unique means of breaking sleet when such conditions occur. Contacts are of the multi-point pressure type.

Because of their limited vertical clearance, these compact units are well suited for installation in restricted space. Mounted vertically, they are especially well adapted for line and bus jack. All current carrying parts of the switch are of high copper alloy and of sufficient cross-sectional area to carry rated load within accepted 30° C. rise.

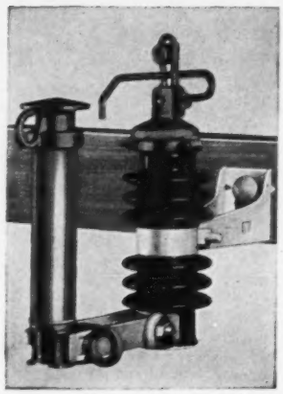
HOOK OPERATED DISCONNECTS

— Kearney N. E. M. A. Hook Operated Disconnect Switches are available in ratings of 7500 through 46,000 volts, 200, 400 and 600 amperes, and also 46,000 volts to 69,000, 600 and 1200 amperes. Multi-point pressure contacts, station post insulators and tubular blades are standard; shoe-type contacts pin and cap insulators and truss-type blades, optional. Switch bases are channel iron and can be drilled for mounting on practically any ordinary wood or steel structures. Terminals can be supplied for use on cable, flat bus or tubing. See Kearney Bulletin 312 for details.



EXPULSION TYPE LIGHTNIN ARRESTER

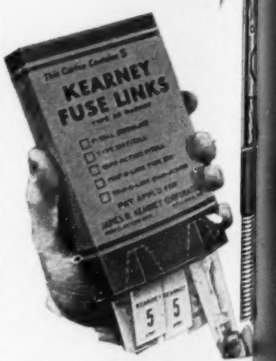
to Protect Equipme



—Kearney Type P Lig ning Arresters, which incorpor the Expulsion Tube Gap princip have impulse ratings of 41,200 amperes and a follow current rating of 3000 amperes. This type of Kearney Arrester is recommended where line to ground short circuit current is of relatively high value.

KEARNEY FUSE LINKS

Kearney Fuse Links are designed for interchangeable use in cutouts which require a flat terminal fuse link, and in cutouts which require the round ½ inch or ¾ inch diameter terminal. Links come packed in handy Pul-Tab Fuse Paks which provide quick identification and convenient handling. There are five fuse links in each Pul-Tab Fuse-Pak, twenty-five links in a carton.



KEARNEY FUSE LINK DISPENSE

Keep five emergency fuse links on the pole using No. 12165 Box Fuse Link Dispenser

FOR BETTER MAINTENANCE and CONSTRUCTION— *Use* KEARNE

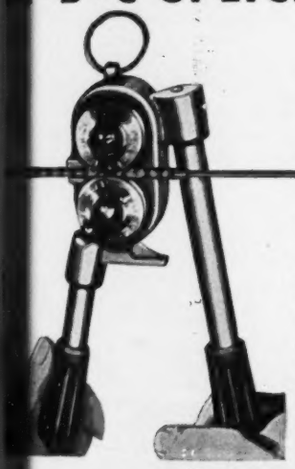
STOP
USING
SOLDER
KEARNEY ST. LOUIS
1/0 STR. C.
Wire sizes of the connector and material of which it is made stamped on Con-Nec-Tite head.
Thread "lead Pilot" permits easy and positive engagement of nut onto the thread.
Patented full-round washer gives a low-friction bearing surface for the nut.

Use KEARNEY CON-NEC-TITES

for making Better Electrical Connections

— Make good, positive, electrical connections, without hazardous use of solder and flaming torch, using modern Kearney Con-Nec-Tites. These widely known Con-Nec-Tites are available in sizes to make any size wire connection, from No. 10 stranded up to 1,000,000 CM Copper. You'll like the "hex" heads, uniform threads, sturdy design and other features of these popular solderless wire connectors.

A•B•C SPLICING MACHINE



— For conserving wire and making good, secure splices every time, use a Kearney ABC Machine to roll sleeves onto conductors to be joined.

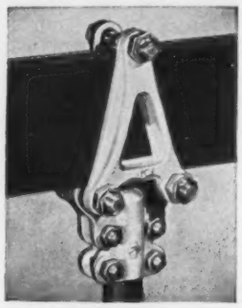
The Principle — Under tremendous pressure, ABC Sleeves are rolled onto conductors. The raised spiral corrugations on the sleeves (note illustration below) are rolled down into the conductor and thus form a tight, compact joint of strength equal to the breaking point of the wire itself. Shown here is the popular moderately priced Kearney No. 6-1 ABC Rolling Machine.

An ABC sleeve before it is rolled.

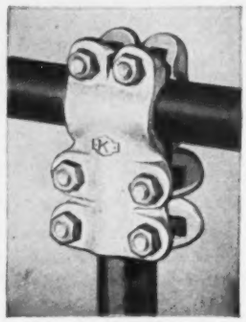
The same sleeve after it was rolled.

POWER CONNECTORS

for Handling Today's Increasing Loads -



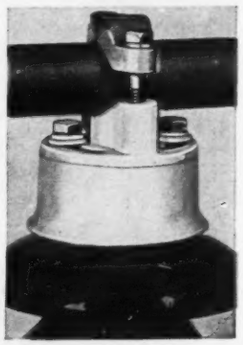
— The Kearney Branch Connector, Flat to Cable Tee Adaptor, Catalog Series No. 10225, shown at left, can be supplied in any standard size. Likewise, the Branch Connectors, Tube to Tube Tee are available for all standard size combinations. These power connectors as well as the many others shown in the Kearney Power Connector and Bus Support Fittings Bulletin No. 316, are modernly designed and sturdily built to meet the requirements for handling today's increasing loads. Special power connectors for particular purposes may also be obtained if necessary. You will find that the alloys used in each of these types of connectors have been selected to combine desirable conductivity, strength, corrosion resistance and low friction. All of these are factors of dependable performance. This entire line is backed by the Kearney guarantee of complete satisfaction.



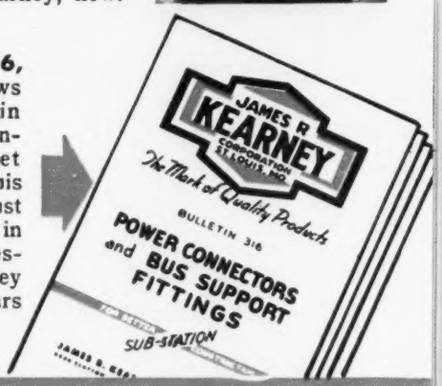
BUS SUPPORT FITTINGS

for Better Substation Construction

— Here shown, at the top, is a popular Kearney Flat Bar Bus Support Fitting, Center Bolt Base Vertical Clamp of the No. 5787 Catalog Series. This series is designed particularly for indoor use. Below is an outdoor type, Round Bus Support Fitting, 3 inch Bolt Circle Base Vee Seat for round, solid or tubular bus. This particular type fitting is of the Kearney Catalog Series No. 9769. Besides the fittings here shown, there are available in the Kearney line special and unusual types which may help to simplify unusual construction problems. Numerous combinations, in many cases, can often be made with interchangeable standard parts. To simplify your problems of outdoor and indoor insulator support choices and to obtain the proper types for specific jobs, start specifying Kearney, now.

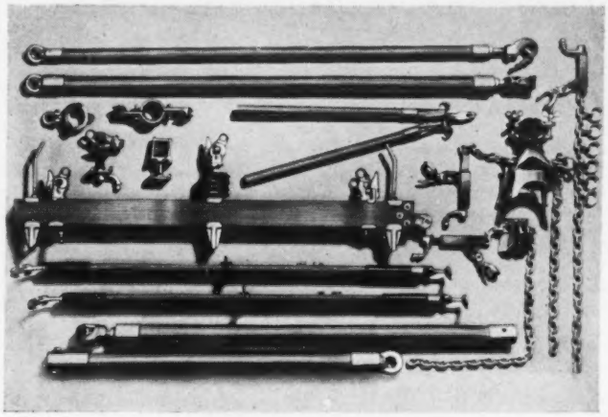


Kearney Bulletin No. 316, an 80-page catalog, shows many practical designs in bus supports and power connectors, designed to meet today's heavier loads. In this bulletin you will find just about anything you need in this line to handle your present constructions . . . Kearney Bulletin No. 316 is yours for the asking.



-PRODUCTS- MADE BY **JAMES R. KEARNEY CORPORATION**
4236 CLAYTON AVE., ST. LOUIS, MO.
CANADIAN PLANT—TORONTO, CANADA

Hi-LINE TOOLS
to Avoid Power Shutdowns



4778-1 KEARNEY TOOL SET

—No. 4778-1 Tool Assortment, shown above, has been assembled for general utility live line work. A few additional tools and accessories make it adaptable for handling a wide variety of constructions and various voltages.

FOR GROUNDING AND TAPPING

—No. 4767 Jumper Clamps for by-passing equipment.

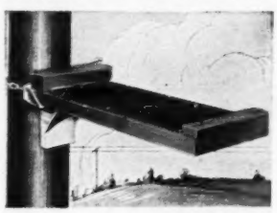
—Spring Type Grounding Clusters No. 7402 are shown at right.

FOR BETTER CONNECTIONS

—Clamp handles from No. 6 solid copper to 1500 MCM. stranded, maximum.

—Kearney No. 3519 Series—Spring Type Con-Nec-Tap Clamps.

SMALL UTILITY PLATFORM



—These platforms are available in two sizes, 24 inch (No. 4905) and 30 inch board (No. 4905-1). Especially handy for emergency jobs.

HANDY SAF-T-HOOK STICK

—Kearney Hook Sticks are provided with pump-action and saf-t-lok features and are used on all mechanical styles of eye screw type clamps, spring type clamps and for installing Kearney Trip-O-Link Fuses. Saf-T-Hook Sticks, series No. 4255, are available in five lengths: 4, 6, 8, 10 and 12 feet. Write for prices and further details.

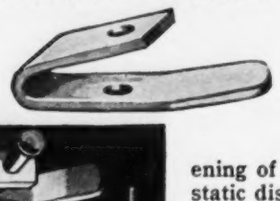
ACCESSORIES
for Line Maintenance and Construction

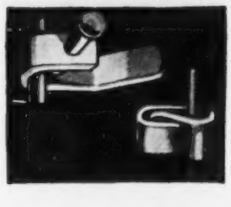
KEARNEY LAY-CIT CABLE GRIPS

supporting cable sizes 3/8" to 1 1/8".

Use Kearney Lay-Cit Cable Grips on multiple conductor service cable or for dead-ending. They "grip" without damage of the braid sheath insulation. They are readily installed, even on continuous cable, and can be easily adjusted to permit releasing or taking up slack. For cable sizes: 3/8" to 1 1/8".

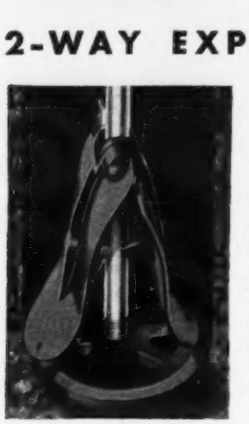
KEARNEY GROUND WIRE CLIPS





—The No. 573 Ground Wire Clip shown, is the means by which operating men have eliminated a lot of radio interference trouble formerly caused when loose ening of ordinary staples often caused static discharge to the ground wire. As shown in the accompanying illustration, they securely hold the ground wire to the pole, regardless of temperature changes or line vibration.

2-WAY EXPANSION ANCHORS



— Select Kearney No. 81 Expansion Anchors and you get holding power of as much as 10,500 pounds in ordinary soil up to 14,000 pounds in clay. Other sizes of anchors have similar security. Specially designed blades expand 2½ times their rated size and have up to 63% of their area in firm undisturbed earth. A heavy disc, reinforced with light ribs, is provided with a recessed socket for the nut that permits salvaging of the rod, when desired. A sturdy anchor, made of Certified Specification Malleable Iron.

KEARNEY PRODUCTS are quality products, fully guaranteed on workmanship, materials and satisfactory service. For dependability and performance at reasonable cost, specify Kearney Overhead and Underground Power Line Equipment.

Solderless Con-Nec-Tites • Trip Out Fuse Switches • Trip-Saver Reclosing Switches • Tripomatic Fuse Cutouts • Trip-O-Link Fuse Switches • Trip-O-Disconnect Switches • Lightning Arrester Disconnect Switches • Hook Operated Disconnect Switches • Sectionalizing Cutouts • By-Pass Disconnect Switches • Pole Top Gang Operated Switches • Porcelain Housed Disconnect Switches • Fuse Links • Fuse Pullers • Expansion Anchors, Screw Anchors • Guy Wire Clips and Strand Bands • Splicing Machines • Dead-End Service Clamps • Hi-Line Tools and Accessories • Con-Nec-Tap Clamps • Grounding Sets • Substation Fittings and Connectors

JAMES R. KEARNEY CORPORATION
4224-42 CLAYTON AVE., ST. LOUIS, MO.

The Mark of JAMES R. KEARNEY *Quality Products*

KEARNEY PRODUCTS *assure better* MAINTENANCE and CONSTRUCTION

SPLIT-FOLD INSERT PAT. APPL'D FOR

tion, and if an undetected leak should occur much valuable electrolyte might be run to the sewer before we were aware of it.

Briefly, the acid detector consists of a number of automobile spark plugs mounted in the pipes carrying condensate; the plugs allow leakage current to flow from the insulated point to the grounded shell, whenever the condensate becomes a conductor at this point. This leakage current is supplied from a 110-volt a.c. source connected to the spark plugs (which are thus connected in parallel) in series with a very sensitive a.c. relay whose contacts energize an a.c. resonating horn, when closed. The power for the horn is taken from the same a.c. source.

On our original acid detector we tried using direct current with a sensitive d.c. relay, but with very poor results due to electrolytic action eating away and fouling our electrodes. The detector was out of commission in less than a month's time.

Using the a.c. and the simple spark plug for the detector electrode we have operated over a two-year period of time without noticeable corrosion or fouling of points and the detector is always on the job, giving an instantaneous alarm. It is an easy matter to remove the spark plugs for inspection at any time.

The relay we use is a small highly sensitive Junior type signal relay such as the Wheelock, type B1-36W, with the following operating and coil characteristics:

Standard operating voltage, 120 volts, 60 cycles.

Minimum volts, 79; maximum continuous volts, 206.

Coil (armature closed) minimum watts, 0.52 or 1.8 voltamp.

Rated watts, 0.62 or 2.2 voltamp. at 110 volts.

Contacts rated at 110 volts, 5 amp.

This detector is so sensitive it will act with ordinary city water in the condensate lines or with a few drops of acid introduced into the condensate.

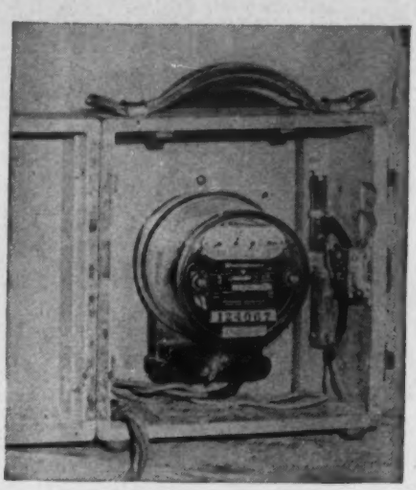
•

Watt-Hour Meter to Measure Power Factor

By R. V. JONES, G. A. COLLINS
San Joaquin Division, P. G. and E.,
Fresno, Calif.

Adaptation of an ordinary 5-amp., 115-volt, single-phase watt-hour meter so that it may be used to measure power factor has solved the need for a simple, inexpensive and rugged instrument for spot power factor checks on fluorescent lighting and gaseous tube sign installations in the San Joaquin power division of the Pacific Gas & Electric Company. The conversion is made by connecting a resistance of the proper value in series with the potential coil of the meter.

It is a well-known fact that at zero power factor a watt-hour meter has zero torque and will not rotate. If the potential applied to the potential coil could be shifted 90 deg., then the meter would have no torque at unity power factor. If this angle could be



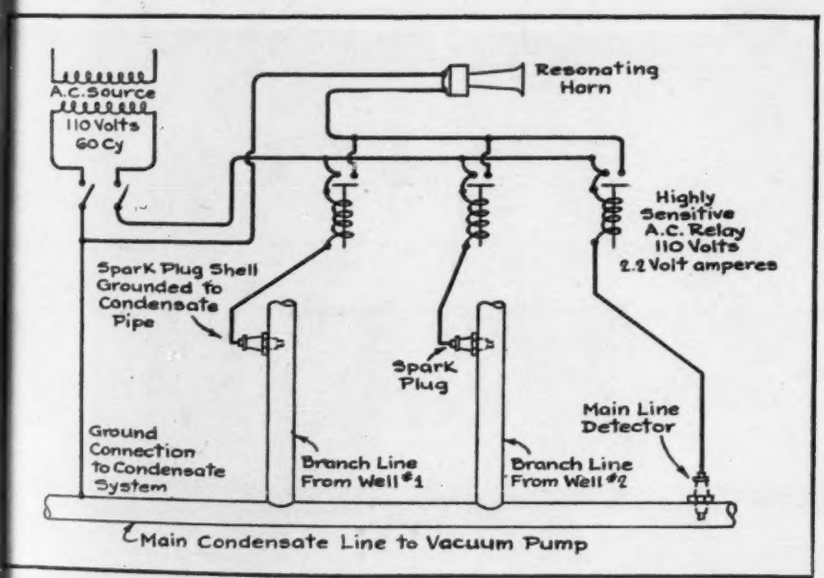
BY CONNECTING a resistance in series with the potential coil of a single-phase watt-hour meter it may be adapted to measurement of power factor. A small type meter is preferable and, together with resistors and switch, is mounted in a neat wooden box for portability

controlled, zero torque could be obtained at any power factor desired, say 90 percent.

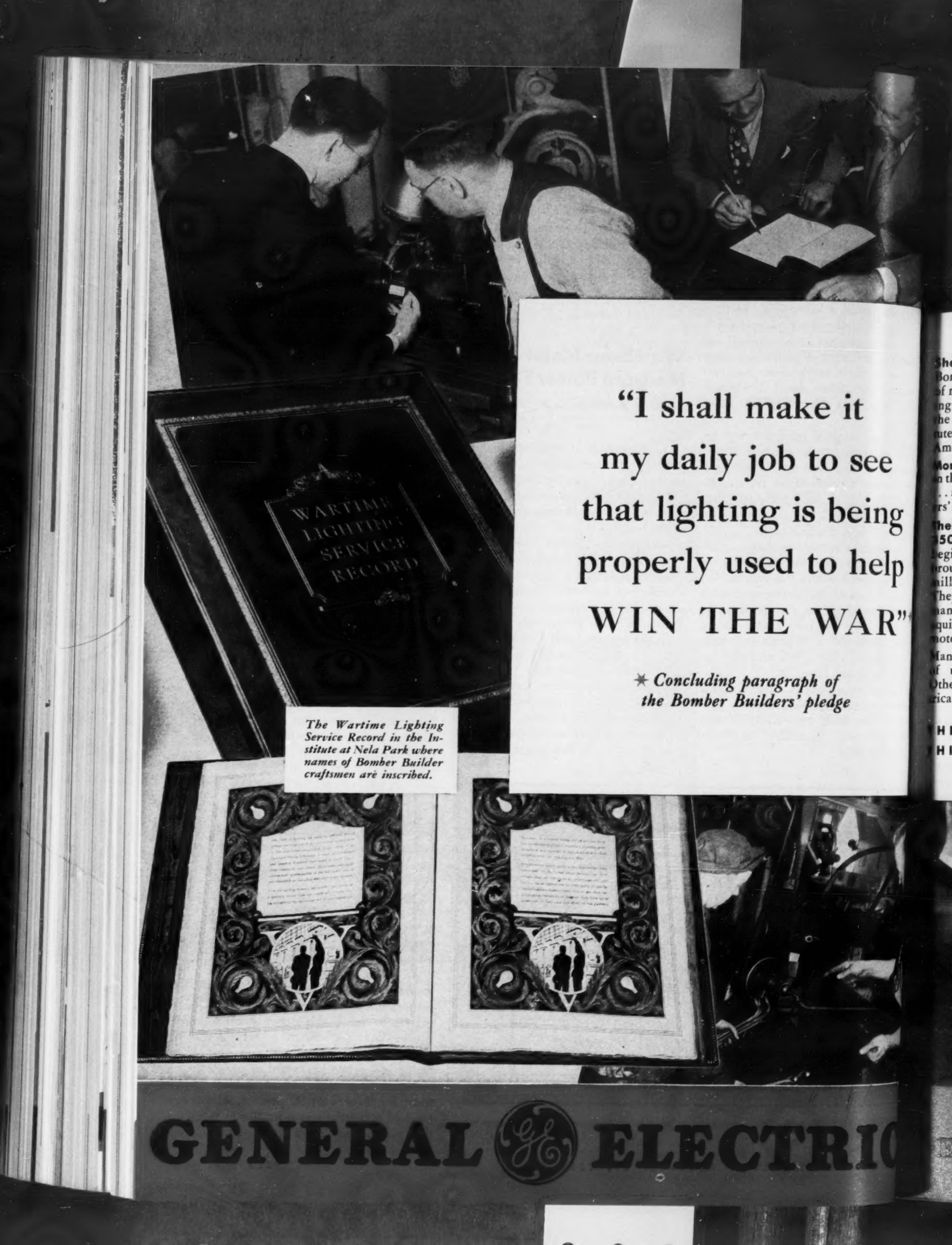
When a resistance is connected in series with an inductance there is a shift in phase of the resulting voltage across the inductance. Advantage is taken of this well-known fact to secure a phase shift of the potential across the potential coil of the watt-hour meter. For a 5-amp., single-phase watt-hour meter the resistance required to produce zero torque at 90 percent power factor lies between 5,800 and 7,000 ohms, depending upon the type of meter. For the particular meter shown in the accompanying photograph the resistance required was 6,700 ohms.

Radio resistors of 25 watts capacity are suitable. Two are used, one being adjustable to permit readily making the adjustment for zero torque at the power factor selected. Since the company's rates call for a power factor of 90 percent or better on fluorescent lighting and gaseous tube signs, the meter was set for zero torque at this value.

A single-pole toggle switch is necessary to shunt out the resistance coils. The meter is first connected as a straight watt-hour meter to check connections for positive rotation. With the resistors switched in, the meter will rotate backward at power factors less than 90 percent and forward for those over 90 percent. The ratio of revolutions as a wattmeter to the revolutions as a power-factor


A.C. Source
110 Volts
60 Cy
Resonating Horn
Highly Sensitive A.C. Relay 110 Volts 2.2 Volt amperes
Spark Plug Shell Grounded to Condensate Pipe
Spark Plug
Main Line Detector
Ground Connection to Condensate System
Branch Line From Well #1
Branch Line From Well #2
Main Condensate Line to Vacuum Pump

AUTOMOTIVE SPARK PLUGS in condensate lines relay leakage current to horn when acidulation rises



"I shall make it my daily job to see that lighting is being properly used to help WIN THE WAR"*

** Concluding paragraph of the Bomber Builders' pledge*

The Wartime Lighting Service Record in the Institute at Nela Park where names of Bomber Builder craftsmen are inscribed.

GENERAL ELECTRIC

Shortly after Pearl Harbor the Bomber Builders, an organization of men from all parts of the lighting industry, was inaugurated by the General Electric Lighting Institute to bring *light for production* to American war industry.

More than a thousand craftsmen in the lighting industry have signed . . . and kept . . . the Bomber Builders' pledge.

These 1023 men have relighted 3500 American war plants since the beginning of the war. They have brought better seeing to almost a million and a half war-workers. They have added almost 90 million man-hours to war production—equivalent to more than 1000 four-motored bombers.

Many of these men were members of utility lighting departments. Others were representatives of electrical distributors' organizations or lighting equipment manufacturers.

The lighting industry has reason to be proud of them all—and all of them deserve their place of honor on the Wartime Lighting Service Record in the Institute at Nela Park.

These men have built for war. But their achievements will carry over into the post-war years a heightened appreciation of the productive benefits of good lighting. General Electric is proud to have had a part in sponsoring the Bomber Builder organization.

More than 600 men have earned the right to wear the gold bomber lapel pin.

Hear the General Electric radio programs: "The G-E All-Girl Orchestra," Sunday, 10 p.m., EWT, NBC; "The World Today" news every weekday, 6:45 p.m., EWT, CBS.

THE BEST INVESTMENT IN THE WORLD IS IN THIS COUNTRY'S FUTURE — BUY WAR BONDS

"Now they tell me-

I shouldn't have used it on an oil fire!"

● This man thought he was doing his duty when he ran for an extinguisher and turned it on a little fire. But nobody had told him that different classes of fire call for different fire-fighting methods. So he used a good extinguisher against the wrong fire—and the blaze soon got out of hand.

The way to make trained fire fighters out of your men is to stage demonstrations. Put your own extinguishers into action against real fires. Explain the different classes of fire and the right way to fight each. A booklet prepared by Walter Kidde & Company tells how to make the demonstration interesting and instructive. Write today for free copy of "How to Teach Fire Fighting."

WALTER KIDDE & COMPANY, INC., 1225 MAIN STREET, BELLEVILLE, N.

meter is a direct measure of the power factor. The following table gives these ratios for the meter illustrated for various power factor values above and below 90 percent.

T_1/T_2 = ratio for use in table below, where T_1 is the time per revolution as a watt-hour meter and T_2 is the time per revolution with resistors cut in. (Using revolutions per minute in each case will give the reverse ratio.)

T_1/T_2	P. F. %	T_1/T_2	P. F. %
—0.340	10	— 6.88	70
—0.527	15	— 9.15	75
—0.753	20	—14.0	80
—1.014	25	—27.9	85
—1.288	30	zero	90
—1.574	35	+20.8	95
—1.937	40	+ 7.47	100
—2.37	45	+ 4.60	95 lead
—2.83	50	+ 3.95	90 lead
—3.51	55	+ 3.35	85 lead
—4.27	60	+ 3.03	80 lead
—5.07	65		

Fifteen of the meters as shown in the accompanying illustration have been made up for the various districts in the division. Test clips are provided on the leads so that the instrument may be readily connected into the circuit. Because of the high accuracy of modern watt-hour meters at large overloads, these meters are used on loads up to 40 amp. with entirely satisfactory results. On the other hand, loads as small as 15 watts are frequently checked.

•

C.T. Core Has Improved Characteristics

By E. C. WENTZ,
Transformer Engineer, Westinghouse Electric & Manufacturing Company, Sharon, Pa.

For years current transformer cores have been made from high silicon content, hot-rolled steel. Now, as a result of the Westinghouse development of Hipersil, such transformers can be provided with a magnetic path that carries two or three times as much flux for the same cross-sectional area, at a given magnetizing force and at low flux densities.

In the construction of a type C core the steel strip is wound on a rectangular mandrel to the required thickness. After annealing and bonding, the core is cut and the gap surfaces are carefully ground to fit snugly. The resulting air gap at the joint is thus held to a very small equivalent length. Nevertheless the ampere turns lost in forcing flux across the gap are of about the same magnitude as the ampere-turns required for the iron circuit. It would appear that the type C construction sacrifices the advantages of the new core material. Actually, the loss is not extremely important because the gap ampere turns are proportional to the flux density. While the effective magnetic reluctance of the core is increased by the gap, more important is the fact that reluctance is practically constant. Fig. 1 shows how much more constant the reluctance of a Hipersil type C core is as compared to the old hot-rolled steel type. It will be noted that at low current values the upward slope of the curves has been greatly reduced. To accomplish the same thing older type current transformers used an auxiliary winding which is now unnecessary. The new core material benefits current transformers in another way. Since permeability is much greater at higher flux densities, heavy burdens can be carried at high over-current without much error. The saturation density, in so far as it affects current transformer performance, is about 10 percent higher for the Hipersil type C core than for the old silicon steel unit. A steel band, drawn to a fixed initial tension, holds the two parts of the core together.

Tests have shown that heating, cooling and severe handling have but negligible effect on the performance. As a matter of fact, such treatment in the laboratory has actually improved the characteristics of the current transformer; the combined effect of these extra forces acting in unison with the tension in the band tend to pull the two pieces into even closer contact. The new unit has been purposely overloaded and overheated while mounted in a vertical position; it has been immersed in salt water for eight hours and then dried for 16 hours, with the cycle repeated for 30 days. Denied even a protective coat of varnish, the test units showed no sign of corrosion or other bad effects as a result of their severe trials.

The marketed product, of course, is dipped in a synthetic varnish which is baked; this seals and cements the whole assembly.

Fig. 2 shows the new current transformer design. It is interesting to note that improved performance has been obtained, paradoxically, in spite of a reduction in cross-section; weight of steel and copper used is less, making the new Hipersil unit about 20 percent lighter than its predecessor.

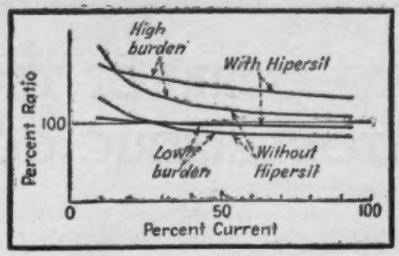


FIG. 1—Curves showing how much more constant the reluctance of a Hipersil type C core is when compared to the old hot-rolled type

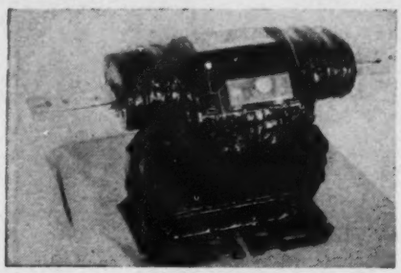


FIG. 2—New current transformer design which provides better performance in spite of reduced size, less steel and copper

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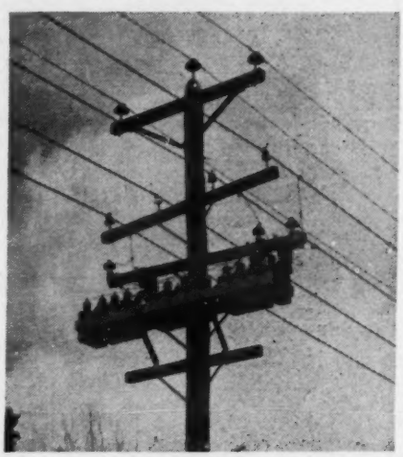
Wartime Capacitor Rack for Poles



Except for spacing bolts and incidental hardware no metal was required for this capacitor rack installation on the lines of the Public Service Company of Oklahoma, Tulsa. Capacitors rest on support lugs between conventional double crossarms joined by four ⅝-in. spacing bolts. Two transmission-type crossarm braces bolted to "kick arm" act as brackets to support the assembly from below.

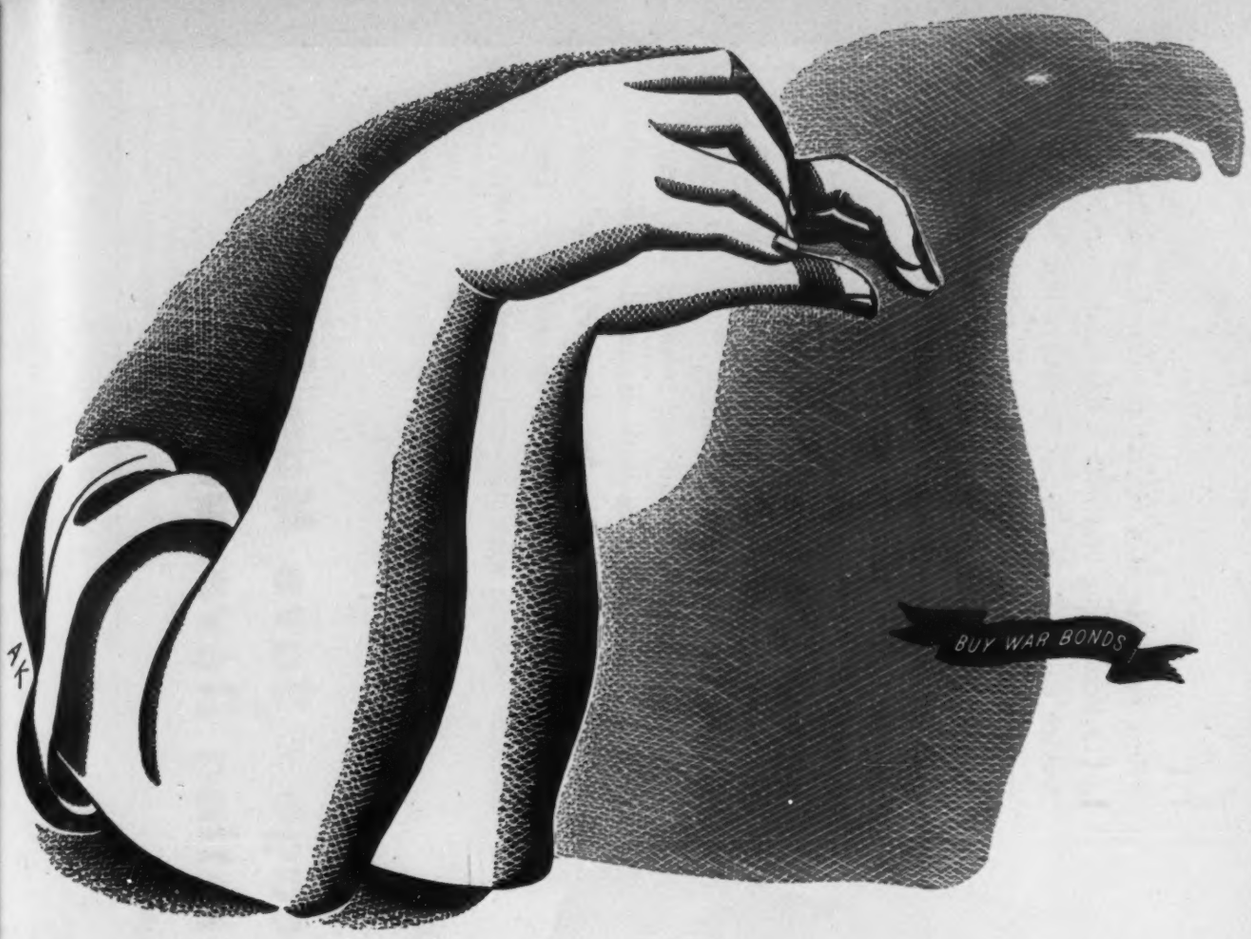
HOW TO CORRECT TROUBLE ON PHOTOELECTRIC CONTROL*

By E. B. McDOWELL, Electronics Section, Industrial Control Engineering Division, General Electric Company, Schenectady, N. Y.

Trouble-Shooting Chart

Trouble	Cause	Remedy
Magnetic relay in photoelectric device does not operate when light to phototube is changed.	No light on phototube, or light reduced below that required for operation.	Check light source. Replace lamp if burned out.
	Light source, phototube holder aperture, or surface from which light is reflected may be out of alignment.	Align correctly and check mounting supports for evidence of vibration.
	Dirt on surfaces through which light passes or from which it is reflected.	Clean the surfaces and inspect at regular intervals.
	Line voltage not within the limits specified.	Correct line voltage.
	Defective tubes.	Check tubes, or if unable to do so, try new ones.
	Positioning key in center of tube base (radio-type tubes) may be broken and tube has been placed in socket incorrectly.	Replace tube. If another one is not available, check alignment of tube pins before replacing in socket.
	Excessive light reaching the phototube from some source other than the light source.	Shield phototube from extraneous light or relocate phototube holder.
	Defective circuit components, such as resistors, capacitors, etc.	If circuit voltages have been included with instructions, check these as a means of locating the trouble. Otherwise, make a visual inspection of the panel for defective parts, and check values of components with suitable testing equipment. Particular attention should be given to electrolytic capacitors, since this type of capacitor has a limited life, and failure may occur after several years of operation. When replacing be sure to observe polarity.
	Excessive leakage in phototube cable or circuit associated with phototube— caused by moisture accumulation or poor insulation.	Check for leakage of phototube cable, phototube socket, and terminals where cable connects to panel. Total leakage-resistance should measure at least 2,000 megohms.
	Open magnetic relay coil.	Replace coil.
Photoelectric relay operates erratically.	Variation in light on phototube resulting from worn lamp contacts or other causes.	Replace lamp. Light source, phototube unit, aperture, or surface from which light is reflected may be moving due to vibration or loose supports.
	Variation in line voltage outside the limits specified for the device.	If possible, use a better regulated power supply, such as is ordinarily used for lighting circuits. Otherwise, install a constant-voltage transformer.
Magnetic relay on the photoelectric unit opens and closes continuously at a rapid rate.	Grounded side of power supply on wrong terminal of photoelectric unit.	In photoelectric relays not provided with anode transformer, grounded side of power supply must be connected to terminal as specified in the instructions. If power supply cannot be grounded, a 1:1 ratio transformer should be installed and the proper terminal of the relay grounded.
	Capacitor which is connected in parallel with the relay coil may be open.	Replace capacitor.
	Filter capacitor in rectifier may be open.	Replace capacitor.
Contacts on "sensitive"-type relays either stick or do not make good contact.	Insufficient wipe of normally closed contacts.	Bend armature stop to obtain about 1/16-in. clearance between armature and contact spring.
	Contacts worn badly.	Replace contacts.

*An inspection schedule, applicable for a preventive-maintenance program, was published in ELECTRICAL WORLD, December 11, 1943, page 105. Also a trouble-shooting chart for electronic control was published in ELECTRICAL WORLD, November 27, 1943, page 80.



What happens when a Shadow meets an RCA Electron Tube

JUST by itself, it's hard enough to measure ... to an accuracy of 1/10,000 of an inch. ...t on a production line, where tens of ...ousands of wires have to measure up to ...s accuracy, it's next to impossible—un...s you want to spend more time measur...g than producing.

However, with a simple electronic device, ...ilt around an RCA Electron Tube, thou...nds of small lead wires for radio tubes ...e now being checked for such accuracy ... the rate of 5 to 8 a minute!

How is it done? Like this . . .

The wire passes before a light. As it ...es, it casts an enlarged shadow on a sensi...e phototube whose output is measured on a meter. If the wire is 1/10,000 of an inch off, the difference is recorded on the meter and the offending wire can be rejected. If desired, the wire can be rotated to measure out-of-roundness.

This is electronics—the so-called "dream science of tomorrow"—in action *today* at RCA. While the device described here is not for sale by RCA, engineers at RCA will be glad to recommend electron tubes around which *your* engineers can design equipment to do any number of jobs better, faster or more economically through electronics.

Remember—the magic brain of all electronic equipment is a Tube... and RCA is the fountain-head of modern tube development. For a fascinating booklet entitled "Electrons in Action at RCA," write Room **459**, RCA Victor Division, RADIO CORPORATION OF AMERICA, Camden, N. J.

TUNE IN "WHAT'S NEW?"

RCA's great new show, Saturday nights, 7 to 8, Eastern War Time, Blue Network.

This machine, while used at RCA to measure the diameter of tungsten wires by an electronic method, embodies a basic principle for measuring any critical dimension of any component that can be made to cast a shadow directly proportional to the dimension to be checked.

RADIO CORPORATION OF AMERICA

TROUBLE-FREE HYDRAULIC OPERATION

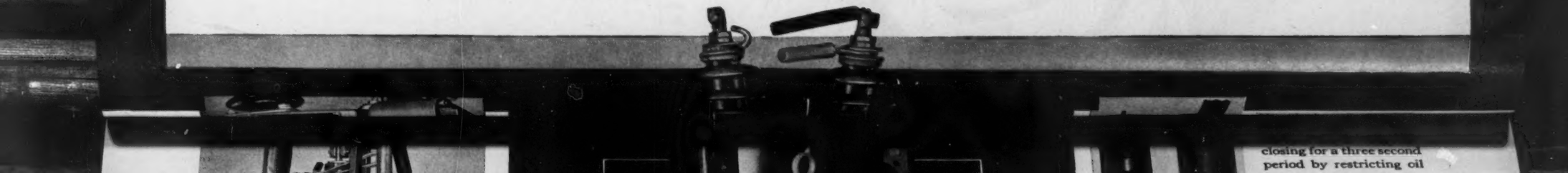
Kyle Oil Circuit Breaker uses absolute minimum of mechanical parts

Prime requisite of a circuit breaker is maximum protection of the line with a minimum number of service calls. Kyle Circuit Breakers not only fill these requirements fully, but are so constructed as to call for a minimum of maintenance.

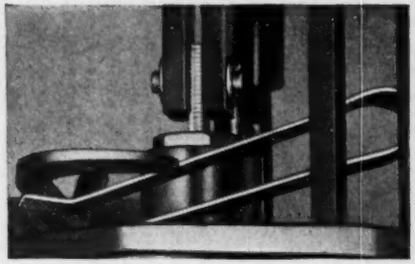
In normal operation, service for the breaker itself may be limited to six months periods or after 75 operations. At these intervals, it is merely necessary to check the oil level—float gauge is located on the cover; test dielectric strength of the oil; check contacts for burning and pitting.

Use of standard transformer bushings and other fittings permits service with standard tools and wrenches. The entire breaker assembly is easily removed from the breaker case in one piece. The breaker operates with standard transformer oil.

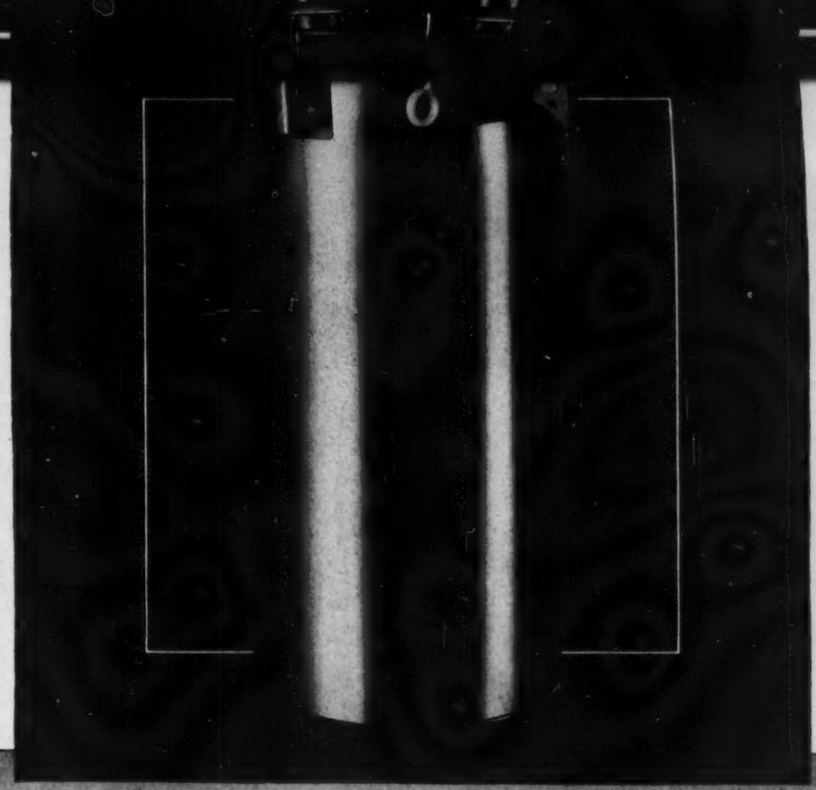
Save Truck Time and Mileage ★ Save Man Hours
Save Loss in Operating Revenue



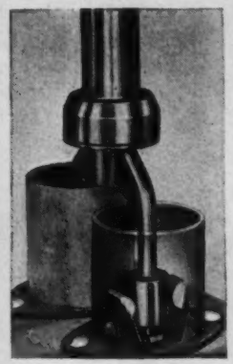
Routine inspection of the Kyle Circuit Breaker is made easy by the removal of four wing nut clamps. The cover supports the entire breaker mechanism. Cover and tank are both "dead" and may be handled safely.



Overloads not sufficient to trip the breaker are frequent causes of damage to breakers and poles. Kyle's thermo-trip will open up the breaker and take it off the line before damage occurs.



closing for a three second period by restricting oil flow past the piston. Final closing of the breaker under persistent faults is accomplished by the release piston (left). This rises on an injection of oil each time the breaker opens. After four operations it is driven high enough to trip the release latch and lock out the breaker.

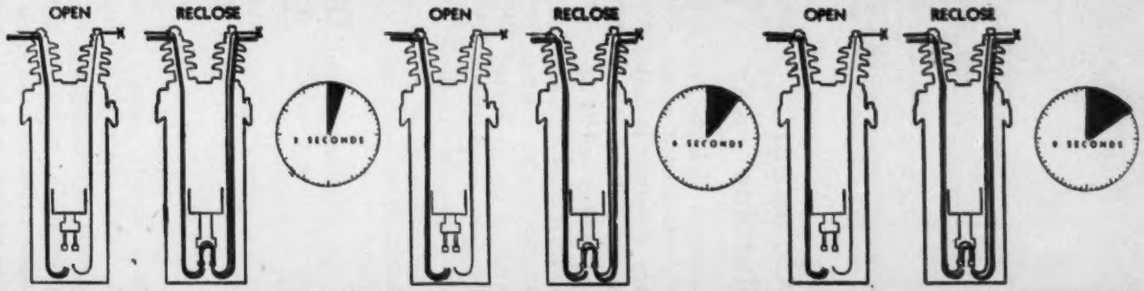


Contacts are protected against flashover with a fiber protecting cup. Note split-type lower stationary contacts, which fit cup-like into the upper movable contacts. Service calls for repair of burned out contacts are reduced by incorporating a double break which increases the rupturing capacity of the breaker.

The special arcing tips which ride on the outside of the upper movable contacts eliminate burning of the main current carrying surface.

HOW THE KYLE CIRCUIT BREAKER OPERATES

Breaker will operate 1, 2 or 3 times and always reset itself for a complete cycle of operations, opening and reclosing at three second intervals. If fault still remains, the breaker LOCKS OUT. When fault condition on the line is corrected, the breaker is manually closed by raising the handle to the up position.

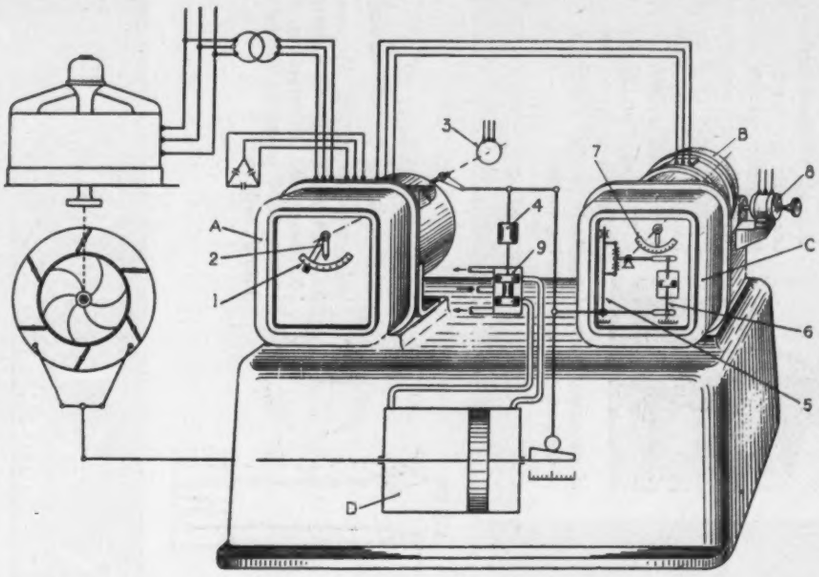


Ratings of The Kyle Circuit Breaker

Volts: 2300 to 15,000. Amperes: 3 to 50. Minimum Tripping Current: 8 to 102 amperes. Interrupting Rating: 120 to 2000 amperes. Weight: 135 pounds with oil.

KYLE CORPORATION

SOUTH MILWAUKEE, WISCONSIN



ELECTRICAL primary governor for hydraulic turbine

Electrical Governor for Hydro-turbine

For speed regulation of hydraulic turbines an equipment known as an electrical primary governor is provided with a stationary electrical frequency measuring system and is designed for direct supply from the main generator. The regulator also insures the positive closure of the hydraulic turbine admission gear upon failure of voltage, without requiring any additional apparatus, according to R. Wild in the Brown Boveri *Review* (Baden, Switzerland).

Referring to the illustration, the primary governor (A) has a visible setting of opening limit (1) and turbine gate opening (2), also a remote control of opening limit (3). The control unit (B) at the right has a three phase choke coil with frequency adjustment (7) and remote control motor (8). The recall device (C) includes independently adjustable permanent speed variations (6) and temporary speed variation (5). A closing weight (4) is used so that upon failure of the voltage the admission parts of the turbine do not tend to open, but close. The servo-motor (D) and relay valve (9) function with the turbine admission gear.

The governor is in itself astatic. Permanent variation is achieved by varying the adjusting choke for the frequency to be maintained by the turbine admission system. The recall feature (temporary variation) can take the form either of an electrical device or of a mechanical one.

Characteristics of the electrical governor make it suitable for adaptation to modern designed turbines as well as for the conversion of older governor forms. In either case the primary regulator takes the place of a fly-ball governor. The unit functions independent of the voltage and governing is stated to be accurate with voltages down to 10 percent of the normal.

•

Distribution Diagram Aids Dispatchers

Large system diagrams, often very elaborately constructed to show all switching details of power plant and substation buses as well as of overhead and underground trunk and tie lines, are commonly to be seen in load dispatchers' offices. But most of these diagrams stop at the substation; they do not show distribution lines. To do so would vastly enlarge and complicate them.

However, the diagram idea has distinct value in keeping track of distribution system conditions as is shown by testimony from the trouble dispatchers' room of the Virginia Electric & Power Company. On one wall of the room containing the telephone desks to which come reports of service troubles and from which line crews are dispatched is a large diagram of the Richmond distribution system. It shows the downtown underground network and all 13.2-, 4- and 2.3-kv primaries. All interconnection, sectionalizing and switching points—pothead, jumpers, taps and pole top or oil switches—are shown. Glove fasteners with different colored caps indicate connection conditions. The fasteners have an additional value in that "hold" and other tags indicating work being done on the system can be placed under the caps.

The greatest value of the diagram is realized during storms and other times when distribution and service troubles pile up. An operator at a trouble desk can get from the diagram almost at a glance information useful in routing line crews or in explaining to a customer why the lights are out.

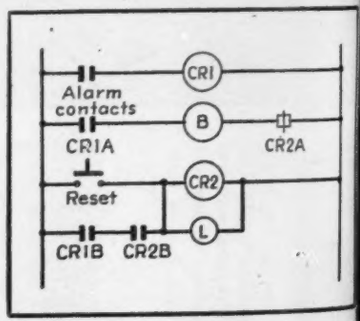
•

Alarm Cutoff Has Automatic Reset

By W. M. ALLCORN
Chief Electrical Engineer,
H. K. Ferguson Co., Cleveland, Ohio

Most signal alarms require some means of manually silencing the alarm bell before the alarm contacts have reopened. Quite often the silencing is done by a simple maintained contact switch and the operator must depend on his memory to reset the switch for subsequent operations.

To overcome the occasional failure of the operator's memory, the H. K. Ferguson Company uses a fairly simple and inexpensive relay scheme to



ALARM reset automatically

Alarm contacts close, energizing relay CR 1, closing contact CR 1A, which connects bell B. Contact CR 1B also closes. To silence bell, operator pushes reset button, energizing relay CR 2, opening contact CR 2A, disconnecting bell. Contact CR 2B also closes, lighting signal lamp and keeping relay CR 2 energized. When alarm contacts open both relays are de-energized and circuit returns to original condition.

... from the
COMPLETE LINE OF
OLIVER
LINE MATERIALS

OLIVER

Underground Cable Racks

For neat, permanent installations of manhole and interior cable work, use Oliver Underground Cable Racks and other line materials. Oliver Racks are readily installed and easily adjusted to conditions (number of cables, size, spacing, etc.). Standard sizes are designed for telephone and smaller diameter power cables. For heavier cables, use Oliver Heavy Cable Racks and Hooks.

RACK HOOKS

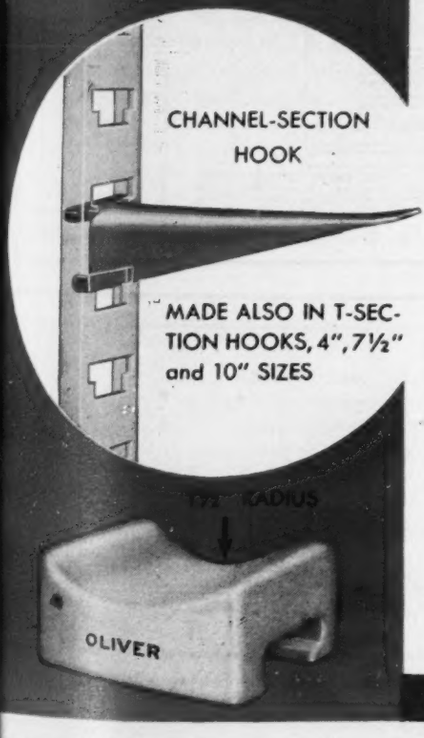
Two types of Rack Hooks are available, T-Section and Channel-Section. Both fit the standard rack, are easy to install and have rounded edges and wide bearing surfaces to prevent damage to the cable sheath. Channel-Section hooks have extra interlocking lugs to prevent rotation of the hook during installation of cables.

INSULATORS

For extra protection, Oliver Insulators can be used with either type of hook. Made of white glazed porcelain with a smooth surface and well rounded corners, they prevent damage to sheath due to "creeping" of cable, and provide extra insulation between cable and hooks.

OTHER ITEMS

The complete line of Oliver Underground Materials includes Anchor Bolts, Duct Shields, Dowell Pins, Pulling-in Irons, Manhole Steps and Ladders. All metal items are made of new rolled steel, hot dip galvanized.



OLIVER
IRON AND STEEL
Corporation

SOUTH TENTH AND MURIEL STREETS · PITTSBURGH, PENNSYLVANIA

provide automatic resetting of the alarm circuit.

The necessary equipment consists of two midget type relays, or contactors, one provided with one normally open and one normally closed contact and the other provided with two normally open contacts, a momentary contact push-button and a pilot lamp. The accompanying diagram indicates the functioning of the equipment. The reset pushbutton clears the bell circuit and sets up the pilot lamp circuit, which remains energized until the alarm contacts open and automatically restore the circuits to the normal condition.

•

How to Test Insulating Materials*

2. Dielectric Constant Tests and Loss Factor

By J. R. FREED
Continental-Diamond Fibre Co., Newark, Del.

A dielectric or insulator has an electrical property known as a dielectric constant which determines the electrostatic energy stored per unit volume for unit potential gradient. The dielectric constant value is a ratio of the equivalent parallel capacitance of a condenser made with the dielectric in question and the capacitance of an identical condenser except that a vacuum or, under normal conditions, air is the dielectric.

The test is run by the resonant circuit resistance variation method (ASTM D-150) as outlined for power factor tests (ELECTRICAL WORLD, December 11, 1943, page 92). A sample of insulating material is placed between two electrodes, thereby constituting a condenser or capacitor, which is measured with a standard precision condenser of known capacitance. The foil electrodes are applied with petrolatum and are of suitable size to provide a capacitance preferably not less than 100 micromicrofarads.

Factors entering into this test are as follows:

The electrodes must be properly aligned and have the exact dimensions of the sample. Careful measurements of sample thickness are necessary. The edge correction (electrostatic flux extending from one electrode to the other) is the same for circular, rectangular or cylindrical electrodes, but must be computed differently for various electrode arrangements. Stray capacitance is the electrostatic flux from the ungrounded electrode to surrounding objects at grounded potential.

Test results may vary with temperature, frequency and moisture conditions. It may also be taken to indicate the purity and uniformity of the dielectric material.

In a laminated product, such as a laminated phenolic plastic, the material is made up of layers with individual dielectric constants and thus may be regarded as a number of capacitors in series. The voltage stress impressed on any layer is proportional to t/K, where t is the thickness and K is the dielectric constant. Uniformity of layers, exclusion of air pockets, voids, occluded gases, moisture film and foreign matter are indicated by the results of dielectric tests.

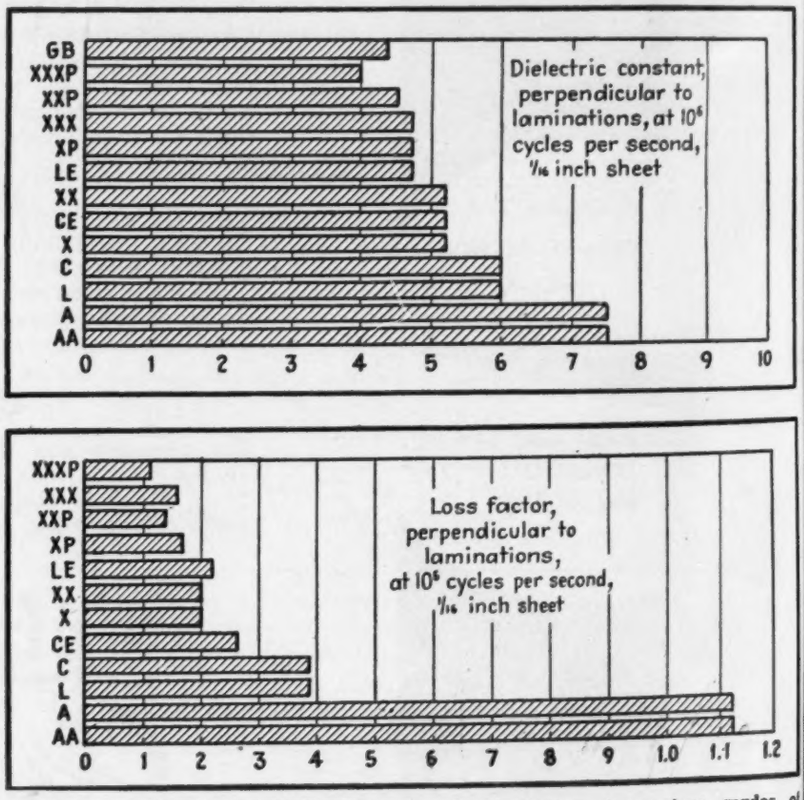
The term "loss factor" refers to the rate at which electrical energy is transformed into heat in an insulating material subjected to a changing electrical field. It is the product of the power factor and dielectric constant; as such it is especially affected by moisture, temperature and frequency changes, and by impurities in the dielectric.

A low loss factor value indicates low internal heating and is usually a good indication of possible performance or life of the insulation in field service. When comparing various insulating materials the loss factor is an important criterion. Although a high dielectric constant may be desirable at times, the power factor and loss factor must be low if losses are to be kept within reasonable limits.

•

Cleaning Tank Saves Time and Work

Much time and a lot of dirty work are saved in the shop of the Alabama Power Company by the use of a large cleaning tank placed accessible to the shop crane. About 10 ft. square and 12 ft. deep, the tank is sufficiently filled with an Oakite solution. In a large steel basket handled by the crane are placed transformer and breaker tanks, hardware of all kinds, any pieces or parts of equipment from which paint, sludge or other dirt is to be removed. The charge remains in the solution from twelve to 24 hours, usually overnight, then is lifted out and the parts washed off and dried.



TYPICAL DIELECTRIC CONSTANTS (top) and loss factors for various grades of laminated phenolic insulations

*This series began in "Electrical World," December 11, 1943, issue.

HOW PANELYTE*

1 ELIMINATE TIME-WASTING EXPERIMENT

2 SPEED YOUR ASSEMBLY

3 SPEED YOUR PRODUCTION

4 GIVE SPECIALIZED DESIGNING AID

CAN HELP YOU *Cut Corners* TO WIN THE WAR *FASTER!*

1 Mechanical and electrical properties of each of the 32 different grades of PANELYTE (paper, fabric, wood veneer, fibre, glass, and asbestos base) are established, as are performance records. With your specifications at hand no time is lost in costly experiment. We can tell you which grade of PANELYTE to use — and its advantages for your application.

2 For the aviation industry alone PANELYTE is now supplying over 2000 electrical and structural parts. Still more parts are shipped "ready for assembly" to every branch of our armed forces. Many of these laminated resinous parts are among the largest and most intricate yet to be molded or fabricated. Straight-line mass production, impractical if not impossible a few years ago, is now our 24 hour daily diet.

3 For 13 years PANELYTE sheets, rods and tubes, molded and fabricated parts have been stepping up production in the Automotive, Aviation, Central Station, Chemical, Communications, Electrical Equipment, Marine, Transportation, Radio, Refrigeration, Petroleum, Textile and Paper industries. Greatly enlarged facilities assure deliveries to meet your schedules.

4 The experience of our engineers is by no means limited to the production of structural laminated plastics. Adept in solving problems of molding and fabrication, they have designed or assisted in the design of PANELYTE parts now recognized as milestones of progress in the electrical and aeronautical fields. If you are engaged in war work their services are at your immediate disposal.

PANELYTE DIVISION, ST. REGIS PAPER COMPANY...AMERICA'S LARGEST PRE-PEARL HARBOR PRODUCER OF THERMO-SETTING MOLDED LAMINATED PLASTICS

PANELYTE *the structural plastic*

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ST. REGIS PAPER COMPANY
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ASS PRODUCTION OF SHEETS, RODS, TUBES, MOLDED FORMS, FABRICATED PARTS

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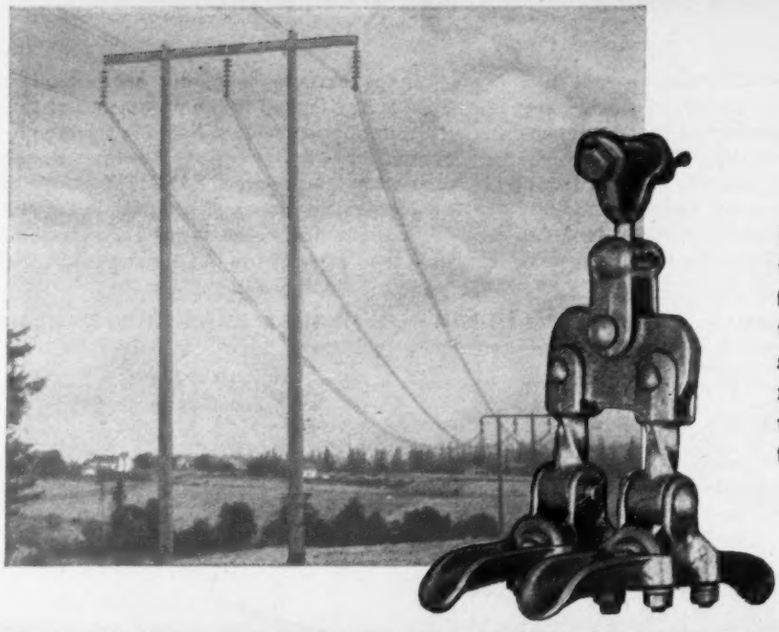
perienced and reliable Fabricators in Industrial Centers from coast-to-coast

Here's how they did it

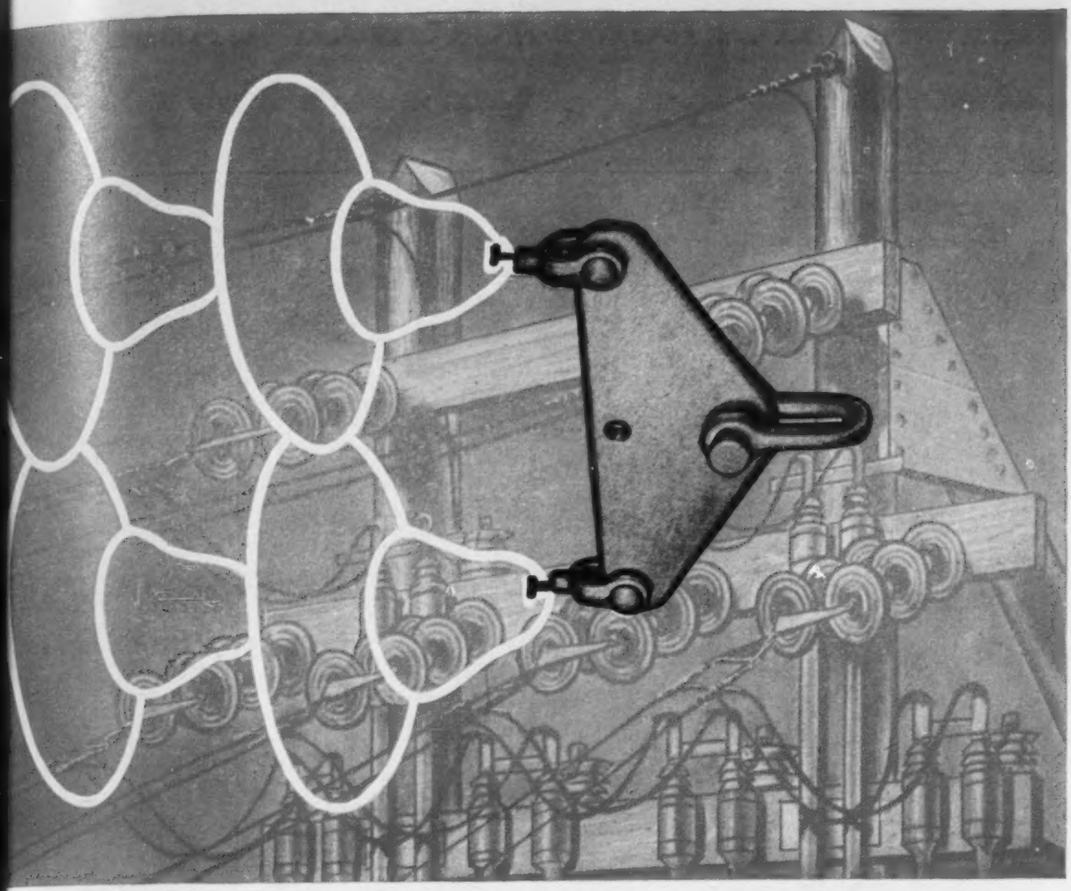


Such service is available t transmission engineers throug their insulator sources, whethe their transmission lines involv standard run-of-the-catalogu materials or assemblies to f unusual conditions, as illus trated above.

HI-TENSION SUSPENSIO

THE BREWER-TITCHENER CORPORATION

...with BTC Cooperation



The transmission and construction engineers for a west coast utility had the responsibility of supplying—RUSH—a large block of power to an important non-ferrous metal working plant.

Due to wartime conditions, it was necessary to use two available cables per phase, rather than the usual one cable of greater carrying capacity.

In cooperation with the engineers, the twin cable design, in horizontal parallel, was worked out and all of the suspension and strain clamps, yoke sets, and fittings supplied by B.T.C.

The assemblies used but ONE SPECIAL PART, the short yoke plate, fabricated from available 1035 flat steel.

Through Your Insulator Manufacturer Only

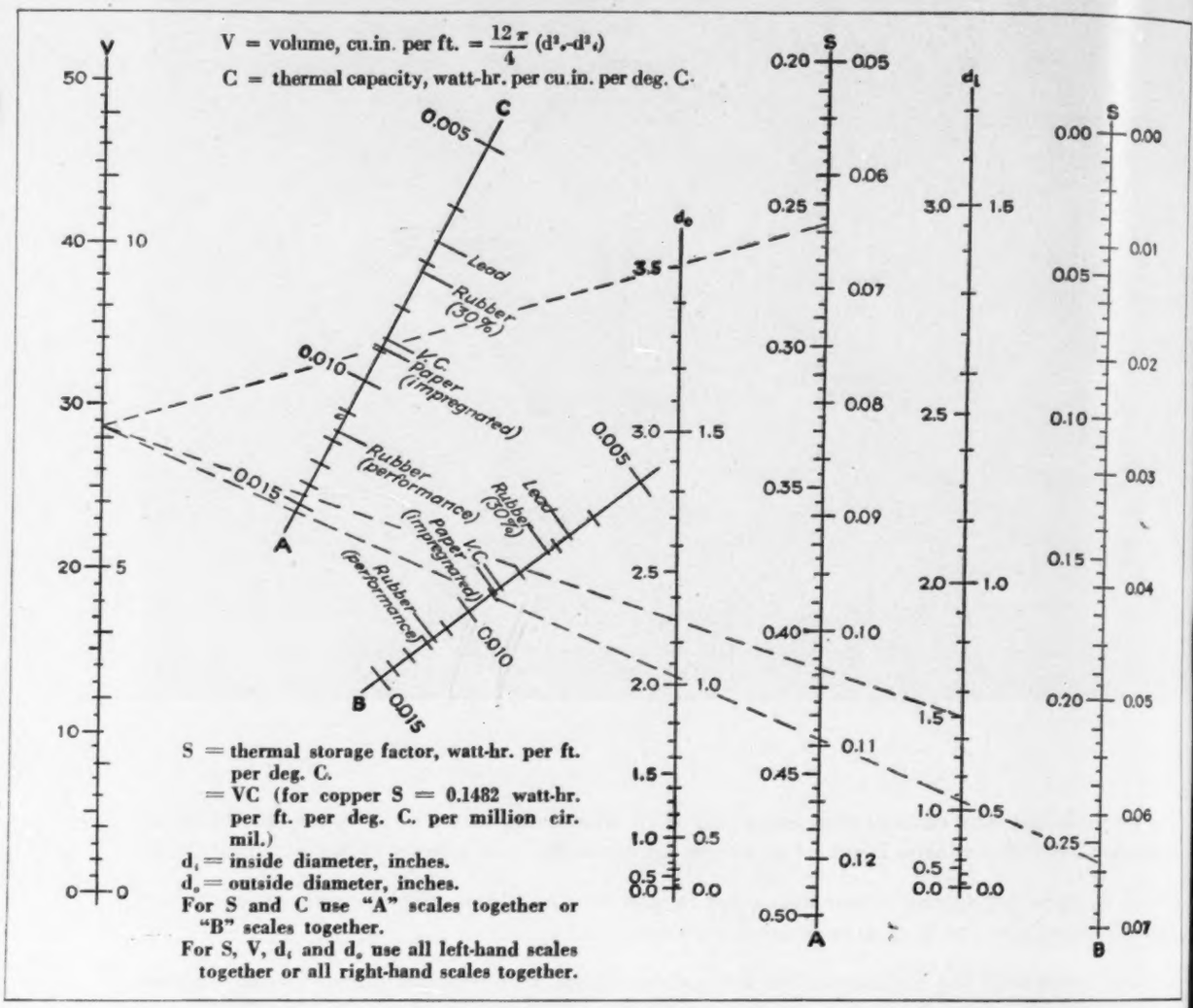
BTC

LINE HARDWARE

CORTLAND, NEW YORK

HOW TO DETERMINE THERMAL STORAGE FACTOR OF CABLE

By L. G. McDOWELL, Assistant Engineer, Consolidated Edison Company of New York, Inc., New York, N. Y.


V = volume, cu.in. per ft. = $\frac{12\pi}{4}(d_o^2 - d_i^2)$
C = thermal capacity, watt-hr. per cu.in. per deg. C.
S = thermal storage factor, watt-hr. per ft. per deg. C.
= VC (for copper S = 0.1482 watt-hr. per ft. per deg. C. per million cir. mil.)
d_i = inside diameter, inches.
d_o = outside diameter, inches.
For S and C use "A" scales together or "B" scales together.
For S, V, d_i and d_o use all left-hand scales together or all right-hand scales together.
Lead
Rubber (30%)
I/C. Paper (impregnated)
Rubber (performance)
Paper (impregnated)
Lead
Rubber (30%)
I/C. Paper (impregnated)
Rubber (performance)
A
B

In the determination of short-time current-carrying capacities of cable the thermal capacity of the cable becomes important. This nomogram simplifies the calculation of thermal storage factors, in watt-hours per foot of cable per degree C., for the insulation and sheath of single-conductor and multi-conductor cables. The symbols "d_o" and "d_i" on the chart refer to the outside and inside diameters of the particular component of the cable under consideration, such as the conductor insulation, the belt insulation, or the lead sheath. For sector conductors, use dimensions for equivalent round conductors. For *n*-conductor cables, the thermal storage factor for the conductor insulation will be *n* times the factor for the insulation of one conductor.

The values of *C* used on the chart correspond to the following constants:

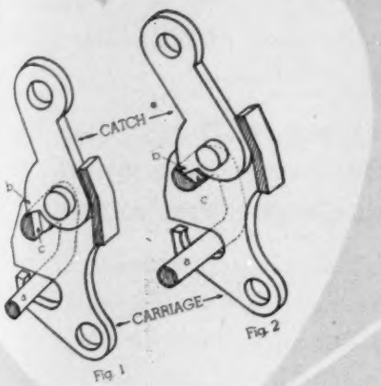
	Density, Lb./ Cu. In.	Thermal Capacity Watt-Hr./Lb./ Deg. C.	Thermal Capacity Watt-Hr./ Cu. In./ Deg. C.
Copper	0.321	0.0480	0.0154
Lead	0.410	0.0160	0.00656
Impregnated paper	0.0506	0.177	0.00895
Rubber (30%)	0.0488	0.147	0.00717
Rubber (performance)	0.0632	0.184	0.0116
Varnished cambric	0.0416	0.210	0.00874

Values for other materials may be spotted easily on the scale for ready reference in future calculations.

Example: To determine the thermal storage factor for 400 mils of impregnated paper insulation on a conductor of 1.5 in. diameter. Using the left-hand scales, a straight line through $d_i = 1.5$ in. and $d_o = 2.3$ in. will intersect the volume scale. A straight line through this intersection and the impregnated paper index on the thermal capacity scale intersects the thermal storage factor scale at 0.257 watt-hr./foot/deg. C. (The volume scale provides a turning point and is calibrated only for convenience.)

HEINEMANN MAGNETIC CIRCUIT BREAKER

bares its Mechanical Heart



This MECHANICAL HEART
(or Latch Mechanism) does double duty . . .

No. 1 It opens breaker with least mechanical delay . . .

When the armature engages the lower leg of the lock (a) it rotates the lock enabling the tooth of the catch (b) to pass through the cut portion of the lock (c), thereby breaking the toggle and releasing the contacts which are under heavy spring pressure. *Of all known latches, this mechanism operates with the least amount of friction.*

No. 2 It opens breaker independent of handle operation.

The relative position of the catch to the carriage remains the same as in Fig. 1 whether the handle is in the "on" position or turned to the "off" position, when the contact is broken manually. The latch collapses only under overload or short circuit conditions—*and it does that even if the handle is purposely held in the "on" position.* Fig. 2 shows the latch on its way to the collapsed position.

Send for CATALOG 40 showing Complete Line and Engineering Data

HEINEMANN CIRCUIT BREAKER CO.

Subsidiary of Heinemann Electric Co., Established 1888

103 PLUM STREET **TRENTON, N. J.**

AT LAST!

A New Sleeving— Flexible as String and Non-Fraying

THIS – NOT THIS

AFTER many experiments, we have developed a super-flexible Fiberglas Sleeving which will not fray.

This sleeving is made by an entirely new, recently-discovered process. Formerly, to prevent excessive fraying, it was necessary to saturate the sleeving, sometimes to a degree where stiffness became objectionable. The new BH Fiberglas Sleeving is as limp and flexible as string—you could tie any kind of a knot with it—yet the severest handling will produce only the merest fuzz at the end.

NON-FRAYING • FLEXIBLE • HEAT-RESISTANT
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How to Close, Trip Circuit Breakers

I. Transformer Tripping with Overload Relays

By G. J. EASLEY
Switchgear Engineer, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

A method which closely parallels the direct-trip attachment scheme uses a tripping transformer with each trip coil in order to allow the use of overload relays. This method is shown in Fig. 1; when the overload relay operates, the trip coil is energized from the bushing current transformer through the tripping transformer. Although this scheme is a little more expensive and requires more space than the direct-trip attachment scheme, it has two advantages: (1) It is less subject to mechanical difficulties and adjustments, and (2) the burden on the bushing transformer is reduced when the overload relay operates, thus insuring more positive tripping.

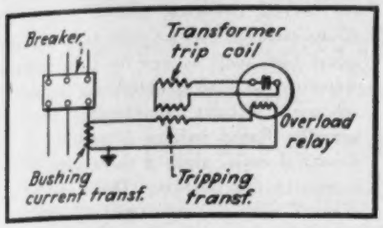


FIG. 1—Schematic diagram of transformer tripping using tripping transformer and overload relay

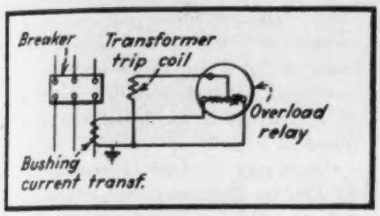


FIG. 2—Schematic diagram of transformer tripping using circuit opening overload relay

A simpler method of using overload relays is shown in Fig. 2. Under normal operating conditions the transformer trip coil is short circuited by the overload relay contact; operation of the overload relay opens this contact to energize the trip coil. This arrangement has the advantage of less total burden on the bushing transformer; however, the burden has a greater percent increase when the overload relay operates than on the two other schemes. This means that greater caution must be used in setting the relay, since a condition which causes the overload relay to operate may not necessarily provide enough energy to operate the trip coil. The chief limitation of this scheme is the current interrupting capacity of the overload relay contact; thus, it must be confined to smaller installations.

*Eleventh in a series of twelve articles which began in August 7, 1943, issue of "Electrical World."

•

Potheads Operated Without Shells

By E. H. GROSSER
Engineer, Equipment Section, Commonwealth Edison Company, Chicago

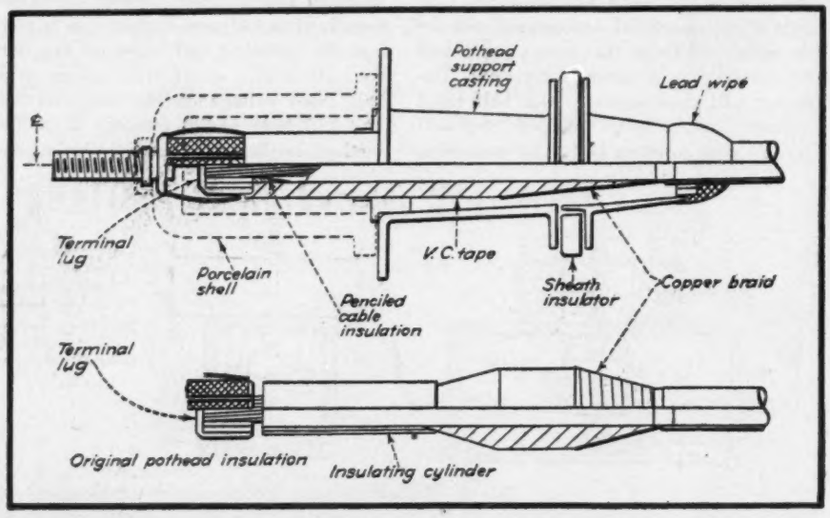
A three-month period has recently been completed on this system during which it was necessary to operate a number of important 22-kv. cable-entrance potheads in transil oil under a moderate hydrostatic pressure without the protection of porcelain shells.

The potheads involved in this temporary operation were on paper-insulated, lead-covered cable between a group of main power transformers and their associated regulators and were installed at the bottom of oil-filled cable entrance boxes on this equipment.

Inspection resulting from a pothead failure disclosed that several pothead shells were cracked in this group of equipment. Due to the normally long period required for delivery of new porcelains, especially under current wartime conditions, it was necessary to devise some method of operating these potheads temporarily until new shells could be obtained. Because of the possibility of slight contamination of the oil in the equipment compartments with moisture, it was decided to reinsulate the potheads so that a longer creepage path would be obtained. This was done as indicated in the accompanying illustration and the potheads placed back in service without porcelain shells. It was not considered that the hydrostatic head of approximately 10 psi. would be harmful to the connected cable during the short period of time necessary to obtain new shells.

Preparatory to reinsulating the potheads the original insulating cylinder was removed and the end of the cable insulation penciled. Low-loss varnished cambric tape was applied over the cable insulation and extended to cover a portion of the terminal lug. Effect of this was to increase the leakage distance and reinforce the insulation between the top edge of the support casting and the cable conductor. This same top inside edge of the support casting was also rounded, as shown, to relieve electrostatic stresses at that point. Wood spacers were also, at this time, added to center the cable in the support casting.

When the new porcelain shells were received they were installed directly over the new reinforced insulation without further change in design. Oil reservoirs were then connected to supply oil to the interior of the potheads at low operating pressures.



MODIFICATION of cable insulation permits three months operation of cable entrance potheads without porcelain shells; potheads were installed in cable entrance boxes on oil-filled apparatus

WARTIME UTILIZATION OF METERING EQUIPMENT

By J. S. WANTLAND,* Foreman, Electrical Laboratory, Oklahoma Gas & Electric Company, Oklahoma City

Following methods for the wartime utilization of metering equipment are possibilities that may be used when the circumstances surrounding a particular job indicate that they are expedient and are not necessarily recommended practices:

Metering Three-Phase, Four-Wire Delta—Certain types of two-element, three-phase meters may be converted to two-element, delta-type meters by replacing the bottom element with the element from a single-phase, three-wire meter of a corresponding manufacturer's type. A multi-circuit or totalizing meter, built for metering combined three-wire, three-phase and three-wire, single-phase, may be also used for metering three-phase, four-wire delta.

Using One-Phase, Three-Wire Meters on One-Phase, Two-Wire Loads—Wartime housing regulations have created demands for single-phase, two-wire meters that are not necessarily commensurate with past policies and stocking procedures. It becomes necessary therefore, to use three-wire, single-phase meters to measure two-wire, single-phase loads.

There are several ways of doing this. Three-wire meters can be connected internally so that they have the same terminal arrangement as a two-wire meter. To do this reconnect the meter coils so the two current coils are in series. One side of the potential coil should also be disconnected from the current coil and reconnected to a separate terminal. The meter will then operate with half rated voltage on the potential coil and will have a dial constant of 1. The method is illustrated schematically in Fig. 1 (a) and (b).

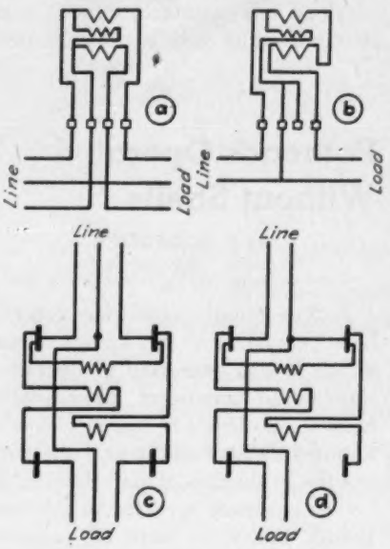


FIG. 1—Two ways of arranging single-phase three-wire meter for single-phase two-wire load
(a) standard three-wire meter. (b) same meter reconnected internally for use on two-wire load, (dial constant is 1). (c) standard 3-wire meter connected to 3-wire load. (d) same meter with external connections changed for connection to two-wire load (dial constant is 2).

Another method is to leave the three-wire meter connected internally in the standard manner, but connect the meter externally so only one current coil is used and the potential coil is across the line. So connected a meter will operate with half rated voltage on the potential coil and will have a dial constant of 2. The method is illustrated in Fig. 1 (c) and (d). By either method the meter should be calibrated with half rated voltage on the potential coil for accuracy at light loads.

Where apartment houses have a three-wire service, but individual apartments are served two-wire, indoor meters for all apartments may be mounted in a large metal box such as are used in primary metering. In such installations the meters are used without reconnecting them internally. Rated voltage is applied to the potential coils, since a three-wire service is run to the building. Only one of the current coils is connected on the load side.

Using Indoor Current Transformers Outdoors—It has been the practice of some companies to use indoor current transformers, installed outdoors in individual wooden boxes on certain loads metered at 5 kv. or less. This idea warrants extended use where wartime conditions indicate its desirability. One method of making such an installation is illustrated in Fig. 2.

Converting Indoor Potential Transformers for Outdoors—Some types of old indoor, oil-filled, two-bushing, potential transformers rated 13,200/110 volts can be converted to outdoor, oil-filled, single-bushing potential transformers rated 6,600/110 volts. To change the ratio it is necessary only to reconnect the two primary coils to operate in parallel instead of series. The original cast-iron transformer case top with two bushings may be replaced with one made from scrap steel plate and outdoor type bushings. Only one primary bushing and a grounded terminal is necessary if the transformer is to operate on a multi-grounded system.

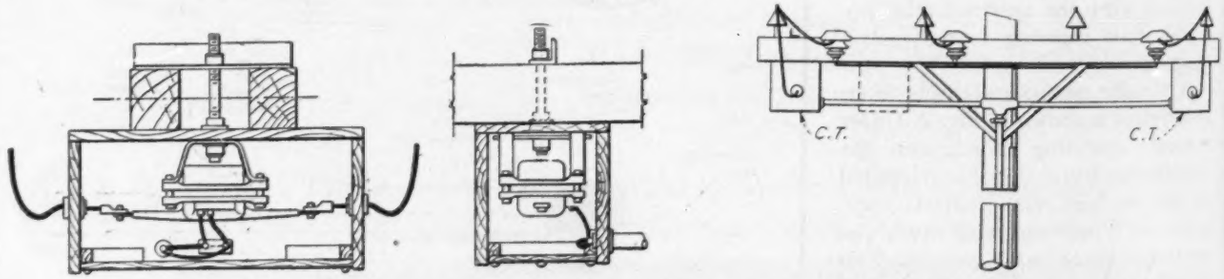
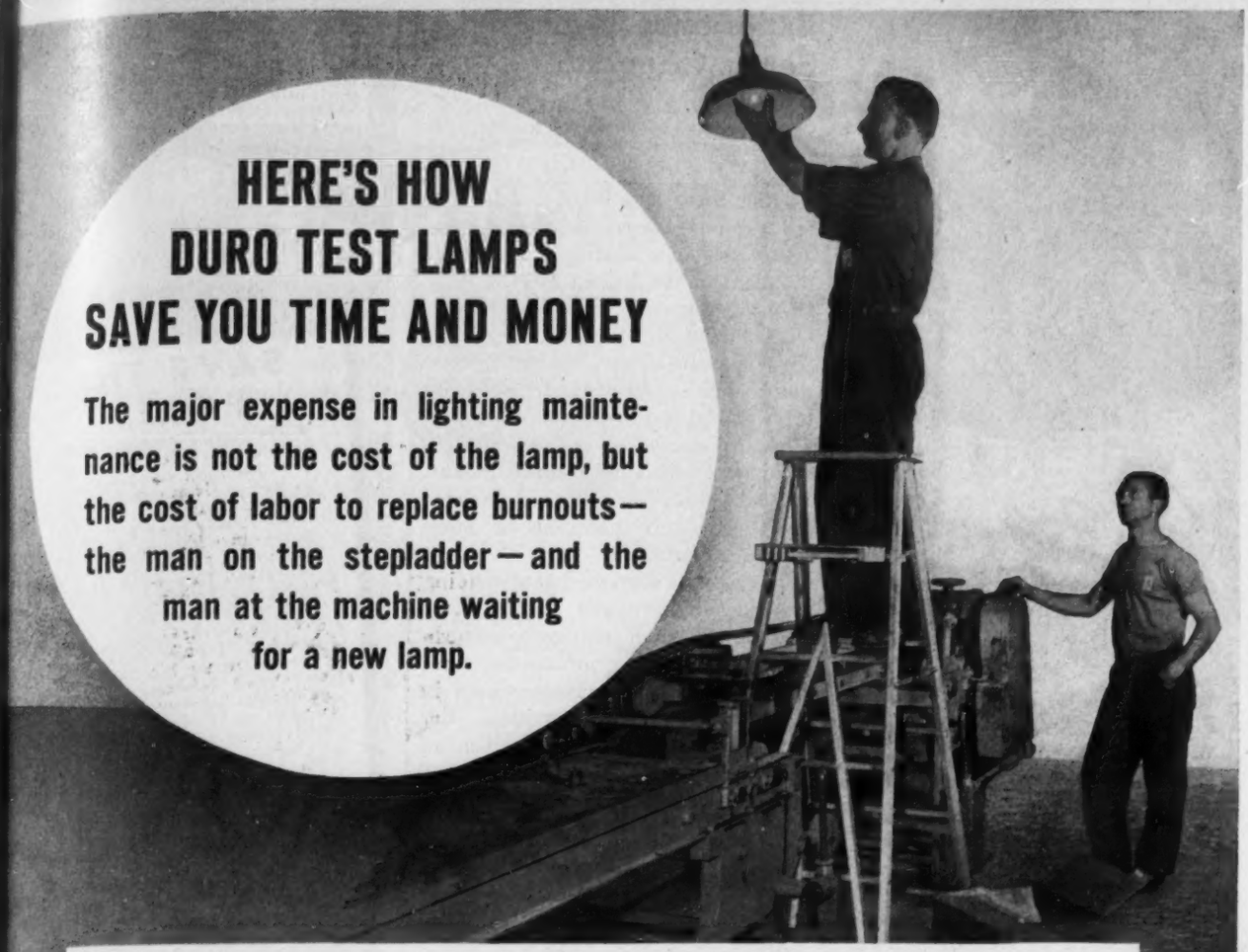


FIG. 2—Method of using indoor current transformers for outdoor service

*From a paper presented by author at Missouri Valley Electric Association Engineering Conference.



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Experience With Series Capacitors

By B. L. McARDLE
Electrical Engineer United Steel & Wire Company, Battle Creek, Mich.*

After three months of satisfactory operation of series capacitors on automatic resistance welding machines in the plant of the United Steel & Wire Company, trouble reared its head. Occasionally in the morning, when the apparatus was inspected before the welders began work, from one to three condensers cans would be found blown up, choke coil in the protective equipment torn loose from its mounting lugs, breakers damaged by arcs and transformers on one or more machines grounded.

It was first suspected that welding transformer grounds might have started off high-frequency disturbances by initiating oscillations, since the capacitance-inductance values in the circuit were rather critical. But that idea did not hold together on analysis. Then it was remembered that the troubles always occurred at night. Possibly the supply voltage was being allowed to go higher than it should.

The series capacitor protective equipment had been set to operate at 555 volts, which had been calculated as a maximum on a +5 percent variation from the nominal 525-volt supply. Investigation disclosed that at night bus voltage in the utility substation from which service was taken would rise for short intervals to values that resulted in 580 volts on the welder supply.

These rises caused the protective device on the capacitor to operate frequently. The protector discharges the capacitor over a carbon arc gap and through a choke coil. Checks showed currents well over 1,500 amp. through the gap and choke. The mechanical forces thus imposed on the choke coil, often repeated, caused it to work loose and finally break away. Then the high-frequency energy in the circuit would seek the shortest path to ground, resulting in damage to and the grounding of much other equipment.

Until a regulator to correct for a +10 percent variation in supply voltage could be installed, the trouble was cured by changing primary taps every night on the main transformers.

*Now in U. S. Army.

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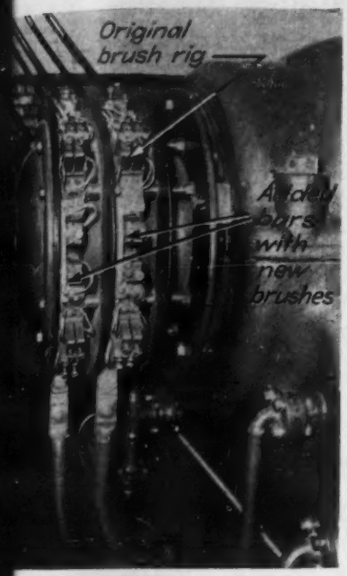
oosted Bus Voltage arts Brush Trouble

When failure of a 12,500-kw. turbo-erator unit last year at the River- station of the Empire District ctric Company required immediate lacement of the capacity to main- n output to meet war industry load- a used machine of similar elec- al characteristics was located and erected at the above station.

Generator rating of the relocated t was 12,500 kw. at 0.90 p.f. oper- ng at 6,600 volts with 125-volt d.c. itation. In the new location gen-



added to original brush holder per- doubling number of brushes; extra hes correct trouble with collector ring rheating and resulting excess brush r

tor bus voltage was 6,900 and ex- tion voltage 130. Also, due to d of maximum output capacity, t was scheduled to operate at 10 cent overload. Operation under e new conditions soon developed uble in the form of overheating resultant excessive wear of collec- ring brushes, with subsequent nage to collector rings.

To correct this condition, caused by rease in excitation current drawn the generator field at the sustained her level of generator terminal tage and machine overload, a rede- n of the brush rigging provided a percent increase in brush contact a by adding twelve brushes to the ginal 32 brushes. The collector g and brush holder assembly with increased number of brushes is

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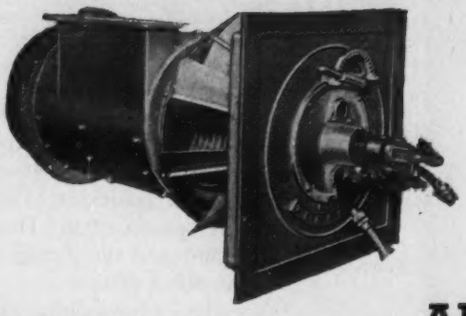

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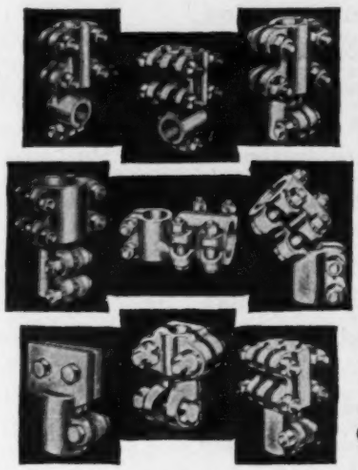

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shown in the accompanying illustration.

This brush arrangement has been in operation for slightly more than a year with no further overheating of collector rings and brushes. But for this renovation the capacity of this unit would have been seriously reduced.

•

Saran Pipe Serves as Insulation

A thermoplastic resin, Saran, is being used instead of rubber for a pipe material because of its insulation value and corrosion resistance. This plastic is a development of the Dow Chemical Company and the piping is produced by modified extrusion.

Some properties of Saran pipe are stated to be: Volume resistivity is 10 to 15 ohms per foot at 77 deg. F. and 10 to 12 ohms at 200 deg. F. Its power factor ranges from 3 to 8 percent at 77 deg. F. and about 10 percent at 200 deg. F. Resistance to heat, continuous, is 170 deg. F. and intermittently, 212 deg. F. Dielectric strength by short-time test for 0.125-in. thickness is 500 volts per mil and for 0.001-in. thickness 3,000 volts per mil. Specific gravity is 1.68 to 1.75. Tensile strength is 4,000 to 8,000 psi. and flexural strength is 15,000 to 17,000 psi. Life expectancy is claimed to exceed that of rubber pipe.

As an electrical application Saran pipe has been used in the mass production of magnesium metal by the electrolyte method at a Dow Magnesium Corporation plant in Michigan. The installation has nearly 4,000 ft. of pipe and fittings on heat exchangers and rectifying units in the rectifier stations.

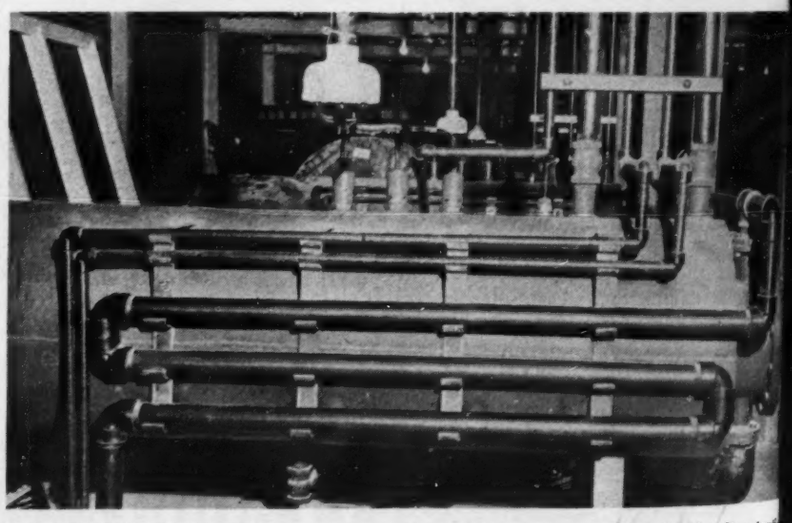
Saran Pipe—Size, Footage and Pressure

Nom. Size, In.	O.D., In.	I.D., In.	Wt.*, Lb./Ft.	Burst. Press.* Lb./In.	Work. Press. Lb./In.
½	0.840	0.546	0.236	1300	
¾	1.050	0.742	0.320	1060	
1	1.315	0.957	0.475	970	
1½	1.660	1.278	0.650	820	
1½	1.900	1.500	0.790	740	
2	2.375	1.939	1.09	620	
2¼	3.875	2.277	1.805	570	
3	3.500	2.842	2.480	510	
3¼	4.000	3.307	3.010	470	
4	4.500	3.749	3.760	460	

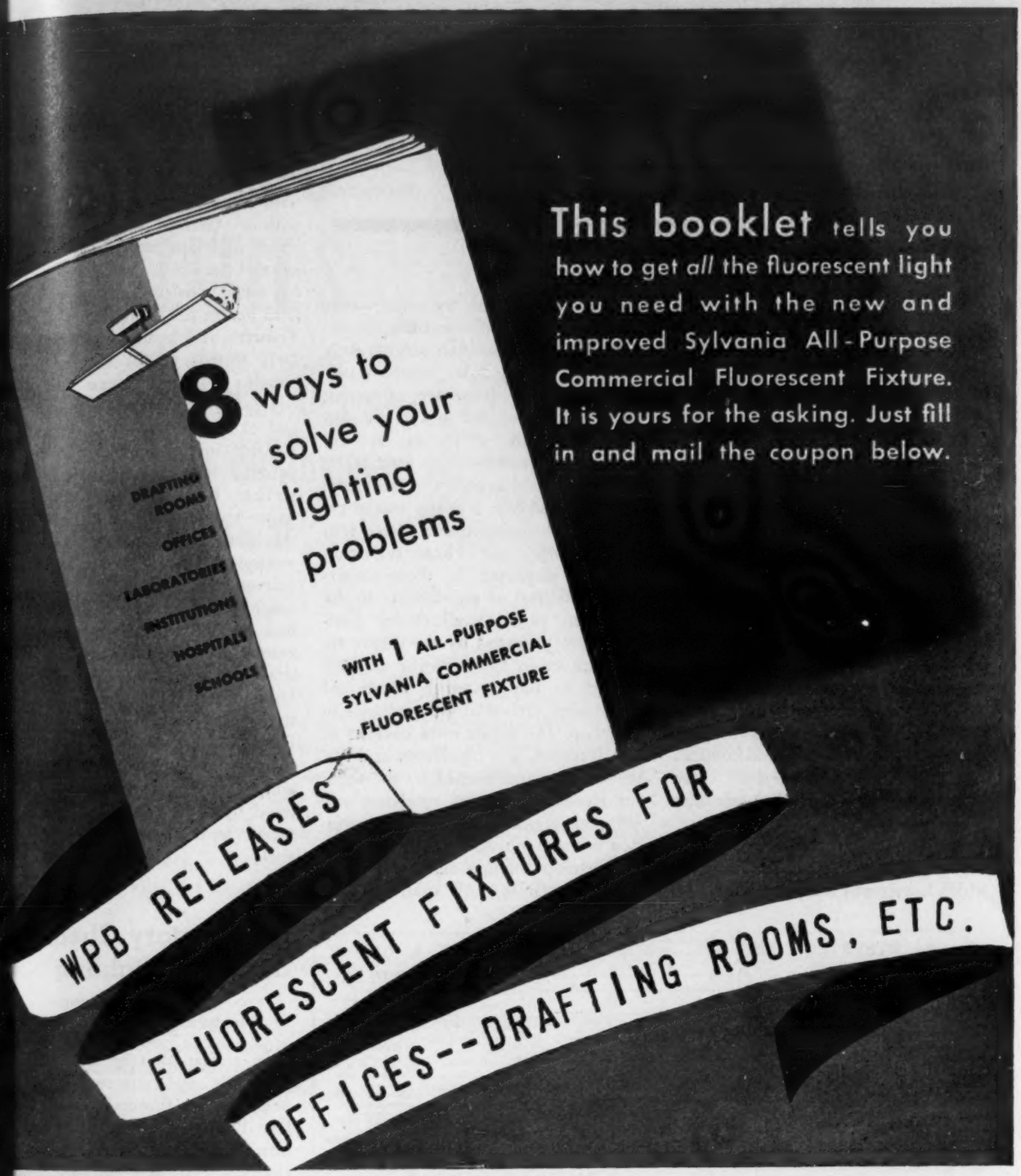
* Calculated.

In the process of rectification from 13,800 volts a.c. to 600 volts d.c. certain power losses occur in the form of heat. The heat is absorbed by water in jackets on each rectifier. A closed circuit, water-circulating system of Saran pipe carries the heated water, varying from 140 to 160 deg. F., to the heat exchangers on the floor below. This water is returned at approximately 85 deg. F. River water is used in the heat exchangers to carry away the heat.

The electrical insulation value of Saran pipe prevents the 600-volt potential of the rectifier water jackets from being grounded through the heat exchangers to the river water piping systems. In addition the corrosion resistance properties of the pipe are said to prevent scaling and fouling of jackets and eliminate the necessity of dismantling of the whole rectifier to locate the trouble.



SARAN PIPE AND FITTINGS on a heat exchanger prevent grounding of 600-volt potential of rectifier water jackets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Keeping Boston's Appliances Fit

By HAROLD T. SIMPSON
Boston Edison Company

Boston Edison Company receives about 1,200 electrical appliances a month for repair, of which about 30 percent are forwarded to authorized manufacturers' representatives for maintenance. The company's repair shop is located at its general service buildings in Boston, and in general, appliances needing attention are brought in weekly by trucks from suburban and more frequently from city stores. Excluding radios and refrigerating units, all other types of appliances are accepted for repair work, including both domestic and commercial equipment. A small stock of repair parts is maintained to minimize repair time.

Most of the clerical details are recorded on tags about 9¾ x 4 in., which has greatly simplified the paper work associated with the repair service. The left tear-off identifies the article, the center position serving as a combination shop order, record of any manufacturer's guarantee, shipping data, repairs wanted and made. On the reverse side of the tag are recorded estimate data, parts used, labor costs and the charge to the customer.

Each appliance arriving at the repair shop is surveyed and sorted into three groups: (a) Those requiring purchase of parts; (b) those requiring transmittal of an estimate to the customer, and (c) all others. Estimates are prepared by the senior repairman or by the surveyor and are mailed to the customer within 24 hours after arrival of the appliance in the shop. The repair crew consists of one foreman, five repairmen and two stockmen, supplemented by the regular stores department receiving and shipping organization. This organization initiates purchase orders for parts and develops the final customer charge on the repair tag. All appliances are electrically tested by the repairman and checked by an inspector after repairing is done. The so-called ground test is made with an S-14 Neon lamp of 2 watts rating in series with the live side of a 120-volt a.c. circuit. Full glow of both electrodes rejects the job as grounded. All appliances with a wattage rating are measured with a standard wattmeter. Maintenance of temperature in irons, roasters and the like is checked with a testing outfit consisting of a thermometer with buzzer to signal the cut-off point. Toasters and heating pads are similarly tested, except that a thermocouple is used. Range and water heater thermostats are tested in a special oven.

After test and inspection, the repaired units are moved to the shipping section. Here they are wrapped in paper and the left stub of the repair tag is attached to the outside of the wrapping. On the next regular truck delivery day they are returned to the neighborhood store. (The company had 442,970 electric meters on its system according to its report to the latest McGraw-Hill Central Station Directory. Many contractor-dealers in the territory also repair appliances.—EDS.) The Edison company strives to provide good service and, through simplicity of detail consistent with good business practice, performs the repair work at fair and reasonable cost.

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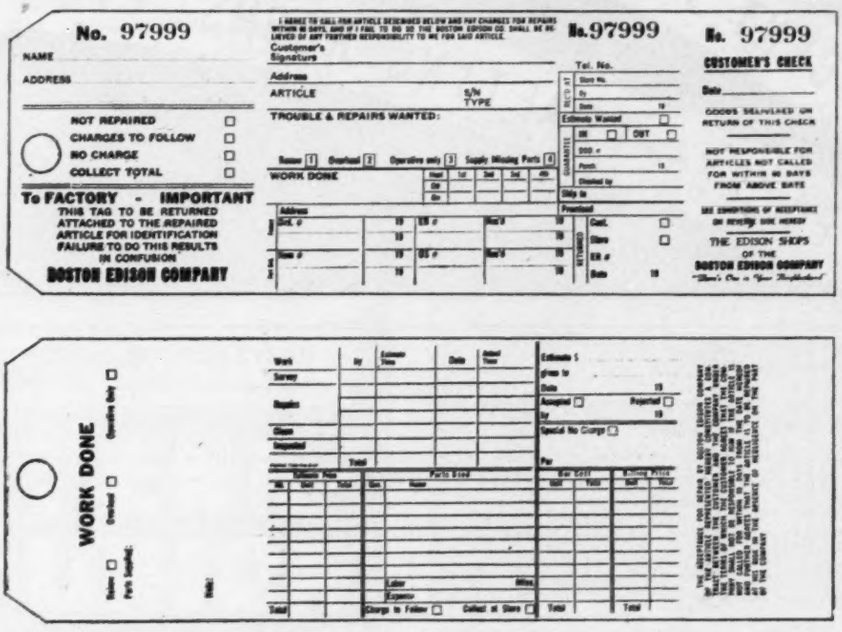


COMPREHENSIVE TAG RECORD saves clerical work and speeds up appliance handling

Preparatory Check-up on Street Lighting

By S. S. BRADFORD
Potomac Edison Company, Hagerstown, Md.*

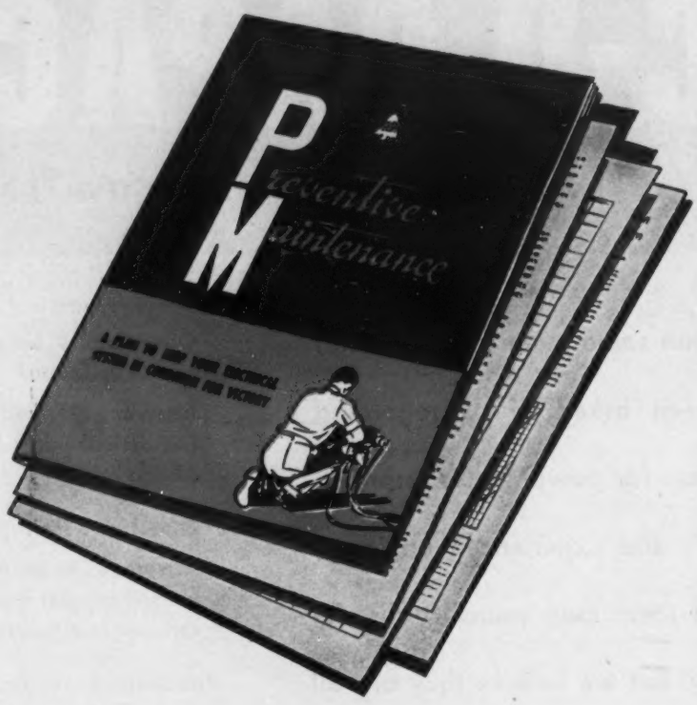
In anticipation of the time when materials and equipments will be available for thorough rehabilitation the Potomac Edison Company is now making a survey of the mechanical condition of street-lighting installations. The survey covers all installations and includes the following: Units with defective or obsolete reflectors; units with defective hoods; units with faulty mounting or suspension devices; those with broken or missing glass; a check-up on cleaning schedules, together with date of last cleaning; requests for suggestions from street-lighting maintenance men.

This survey, covering all sma

* From paper to Southeastern Electric Exchan

OVER 60 UTILITIES

using PM plan to help power customers avoid Electrical Breakdowns



Introduced a short time ago, Anaconda's Preventive Maintenance Plan is being widely used by utilities to help customers keep electrical systems operating *efficiently*—despite shortages in essential wiring equipment.

Already some 60 utilities are actively engaged in this program. With it, they are helping their industrial power customers maintain continuous wartime production by preventing electrical breakdowns.

WHAT THE PLAN IS

The PM plan is a simple but comprehensive way to safeguard war production by preventing electrical breakdowns *before they develop*.

HOW IT WORKS

The plan provides a practical means of making periodic, systematic analysis of circuits and equipment. Uncovers potential weaknesses . . . suggests ways to correct them . . . prevents overloading of lines.

Data thus gathered aids local W.P.B. Branches in reaching decisions on requests for materials to *prevent* breakdowns.

HOW UTILITIES BENEFIT

The PM plan helps utilities maintain close customer contact despite a lack of "something to sell." Offers basis for service campaign that definitely appeals to customers. Puts the utility in a leadership role for furthering war production throughout the area it serves.

If you aren't already utilizing the Anaconda Preventive Maintenance Plan, mail the coupon for full details.

43237

"Tomorrow may be too late . . . do it today!"

ANACONDA'S PREVENTIVE MAINTENANCE PLAN

Anaconda Wire & Cable Company
25 Broadway, New York City 4

Please send copy of the Anaconda Preventive Maintenance Plan for safeguarding wartime production.

Individual .....

Company .....

Address ..... City .....

12L

C-D CAPACITORS

We submit some more questions that have been asked of us regarding Capacitors for power-factor improvement. To the experienced engineer, some of them may sound fairly elementary. But we believe they are all questions that spring to mind when an executive is planning an investment in power-factor equipment.

Question: *What about maintenance on power-factor improvement capacitor installations?*

Answer: Practically no maintenance is required. Our records indicate that installations put in as much as ten and fifteen years ago are still operating efficiently.

Question: *Do capacitors use critical materials?*

Answer: The use of critical materials in a capacitor installation – in comparison to other types of corrective equipment is insignificant. Hence, C-D can supply capacitors to you quickly and as you want them.

Question: *Suppose there are occasional conditions of leading power-factor?*

Answer: Rarely does the fact that the power-factor is leading cause difficulty. However, the voltage rise caused by the application of the capacitor may become excessive, somewhere around 100% power factor and it may be necessary to switch part of the capacitor equipment off.

Question: *Are capacitors a good investment?*

Answer: Yes, they are a good investment because they will alleviate the critical power shortage in your plant at the present time and save the need of purchasing new transformers and new wiring which involve much more critical material. Also, you may realize a reduction in power costs from your improved power-factor.

Question: *What is Dykanol?*

Answer: Dykanol is the impregnant used in C-D capacitors for power-factor improvement. It is a non-inflammable, non-explosive synthetic impregnant of unusually high insulation resistance, high dielectric constant, high voltage breakdown, low power-factor and extremely high chemical stability under all operating conditions.

Question: *When can I get more information on Power-Factor equipment?*

Answer: A C-D Power Factor engineer will be glad to cooperate with you and, remember: only C-D capacitors are backed by the experience gained thru thirty-three years of capacitor specialization. Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

Cornell Dubilier Capacitors

WORLD'S LARGEST MANUFACTURER OF CAPACITORS – 1910-19

communities as well as the towns and cities, contemplates not only caring for any deferred maintenance but will provide data that will prove helpful in negotiating any contracts coming up for renewal, and in developing improved lighting installations as well as new installations and extensions.

The survey will be followed by the preparation of maps and recommendations in the order of their possible development, to be used as a basis for starting negotiations now or later.

•

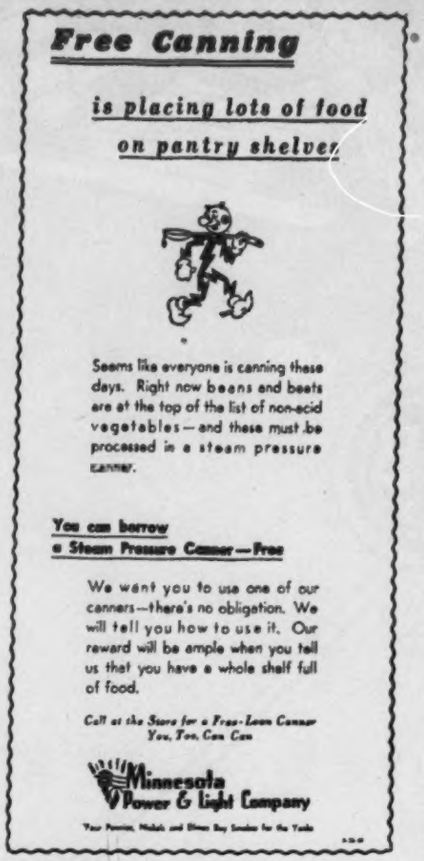
Duluth Utility Lends Pressure Canners

By R. F. PULVER
General Sales Manager Minnesota Power & Light Company, Duluth, Minn.

Fifty steam pressure cookers, put in the hands of local homemakers on a loan basis by this company during the 1943 canning season, have placed more than 18,000 pints of preserved food on pantry shelves in the Duluth area, food which, in all probability, might have been wasted for want of high-temperature facilities for canning. During the season each of the 50 canners has been used on an average of ten full days each and has processed an average of 38 pints per day or 380 pints total.

Our company has dealt with food for many years through its interest in electric cooking and refrigeration. In 1943 it was natural to continue our interest by holding clinics and food preservation demonstrations throughout our service area. As the season wore on, however, it became apparent that unless high-temperature facilities were made available for canning much non-acid food would be wasted at a time when food conservation was vital.

The loaning of such food preservation equipment to our customers became possible late in the season when manufacturers of pressure canners were enabled to deliver such equipment upon Agricultural Board certification that the equipment was needed and would be put to good use. We obtained such certification and through local channels secured the delivery of 50 steam pressure canners, which were immediately placed in the hands of homemakers on a loan basis.


Free Canning
is placing lots of food on pantry shelves
Seems like everyone is canning these days. Right now beans and beets are at the top of the list of non-acid vegetables—and these must be processed in a steam pressure canner.
You can borrow a Steam Pressure Canner—Free
We want you to use one of our canners—there's no obligation. We will tell you how to use it. Our reward will be ample when you tell us that you have a whole shelf full of food.
Call at the Store for a Free-Loan Canner
You, Too, Can Can
Minnesota Power & Light Company

ADVERTISING tells homemakers of plan to loan pressure canners free

We had two objectives in mind in loaning this equipment: We were sincerely interested in augmenting and protecting our food supply and we were desirous of being helpful as good citizens.

Simplicity was the keynote of the loan plan. To secure a canner on loan it was merely necessary to come to one of our stores, borrow the canner and leave a receipt and a promise to return it promptly.

At the height of the canning season the canners were loaned for only one day (24 hours) at a time. When the rush was over this time limit was extended to any reasonable request when it could be seen that the request was genuine.

Many difficulties were anticipated from inexperience and disappointments. None of these things happened, however, and the results of the project were that much more gratifying. Instructions were given verbally to each borrower before the canner was released. A mimeographed guide was also supplied. There were only one or two instances where the canners could have had better treatment. There were no losses.

The results more than justified our expense and effort. Various expressions of good will were numerous. The publicity was widespread and abundant, although a relatively small amount of advertising was directed to this project.

As the vegetable season drew to a close we suggested the canning of poultry and game. Although we were late in getting the project started, this was not serious in our part of the country, where seasons are late. Earlier availability could possibly have doubled our quantity of processed food. We look for much bigger results next year.

• • •

One Stone, Two Birds

Your Government Needs Your Help!
IMPORTANT!
You will not receive a Bill this month
To conserve manpower and materials, the Company will read your electric service meter and send you a bill every two months.
If you are paying for merchandise on the installment plan, you will be billed for two monthly installments with your service bill.
The Company sincerely asks for your cooperation in working out this wartime change which is made in an effort to conserve manpower and materials and hasten the day of victory.
DON'T WASTE ELECTRICITY
PUGET SOUND POWER & LIGHT COMPANY

BI-MONTHLY BILLING NOTICE carries conservation message

WHEN INDUSTRY RE-WIRES

Thousands of electrical re-wiring problems needing fitting answers are bound to come up at the outbreak of peace. Electrical engineers and others who require engineering facts and specification data on the latest raceway fittings plus solderless lugs and connectors of all types are invited to consult T & B Catalog 44. It is fully illustrated with charts, technical data and installation information. Kindly use your company letter-head in writing for complimentary copy.

All T & B products are distributed exclusively through the Electrical Wholesaler.

T&B

THE THOMAS & BETTS CO.

INCORPORATED

MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1899

ELIZABETH, NEW JERSEY

In Canada: Thomas & Betts Ltd. Montreal

E Flag awarded April, 1943

...ner awarded October, 1943

NEW EQUIPMENT

Meter

Portable instrument for measuring the resistance of insulation consists of a conventional electronic rectifier, a Thyrite bridge circuit and an electronic-tube volt-

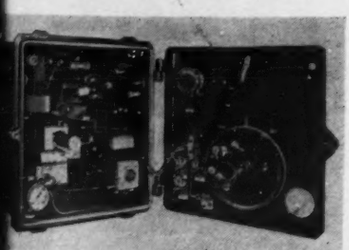
Electronic insulation-resistance meter; 115 volts, 60 cycles, one type has scale calibrated from 1 to 50 megohms and measures resistance at 500 volts d.c., another type has a 0-20,000 megohm total range and measures resistance from 0-5 megohms at 0-250 volts d.c. and 5-200, 50-2,000 and 500-20,000 megohms at 500 volts d.c. **General Electric Co.**, Schenectady, N. Y.

meter. In the operation of the meter the single-range selector switch is turned to the lowest range and the power switch is turned on. If necessary the selector switch is turned to successively higher ranges until the pointer of the illuminated scale is in the center portion of the scale. The resistance of the material under test is read directly in megohms.

•

Pneumatic Controller

The instrument consists of an original electray controller, with it mirror galvanometer and photoelectric amplifier, combined with a pneumatic follow-up. Measuring circuit in this instrument is identical with the standard controller, but in place of the relay found in the controller there has been substituted a magnetic air-valve which acts as an amplifier and converter from electric to pneumatic operation.



"Electray" pneumatic indicating controller. **J. Tagliabue Mfg. Co.**, 550 Park Ave., Brooklyn, 5, N. Y.

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Inductors

Air inductors; capacities for electronic heating applications up to 1 kw. **Barker & Williamson**, 235 Fairfield Ave., Upper Darby, Pa.

Broad assortment of heavy-duty coils of "air-wound" design (no solid winding form) are wound to uniform pitch, have terminal strips and plugs and are adaptable to numerous mounting arrangements. They are said to lend themselves readily to mechanical and electrical revisions in circuits that must be adjusted, or which are still in the experimental stage.

•

Fluorescent Fixtures

"Parkway" and "Crusader" lighting fixtures; use four 40-watt, 110-volt fluorescent lamps. **Day-Brite Lighting, Inc.**, 5411 Bulwer Ave., St. Louis, 7, Mo.

"Parkway" fixture is an open type. "Crusader" fixture has side panels of die-formed, diffuse plastic and ivory enamel finished wood louvers; the entire body is snapped to the chassis by spring-tension clips. Body of latter can be used on the former to convert the open type unit to inclosed type. Both styles have wood end plates, are furnished wired and include sockets, starters and ballasts, and are available for ceiling or suspension mounting.

•

Welding Positioner

"Model WP-2" welding positioner; capacity 2500 lbs. **Harnischfeger Corp.**, Milwaukee, Wis.

Positioner for welding has 42-in. diameter table with 18 slots for mounting fixtures and is turned manually to suit welding speed. Tilting is controlled by hydraulic power with 135 deg. beyond horizontal position attainable. Telescopic column with self-locating stops provides for table elevation from 38-in. minimum to 60-in. maximum from floor, depending on type of mounting (portable or column-in-floor). Table can be arranged for turning with foot or push-button control.

BUYING ELECTRICAL EQUIPMENT?—McGraw-Hill's *Electrical Buyers Reference* is a convenient place to look first for manufacturers' product data, names and addresses.

Capacitors

For high-voltage d.c. applications where space is limited, capacitor elements are hermetically sealed in a tubular, wet-process porcelain body with solder-sealed end clos-

"Type FPC" porcelain-clad Inerteen capacitors; d.c. voltage ratings from 7,500 up to and including 200,000. **Westinghouse Electric & Mfg. Co.**, Department 7-N-20, East Pittsburgh, Pa.

ures. The end closures act as the capacitor terminal by connecting the element leads at opposite ends, utilizing the porcelain tube as insulation.

•

Eutectic Alloy

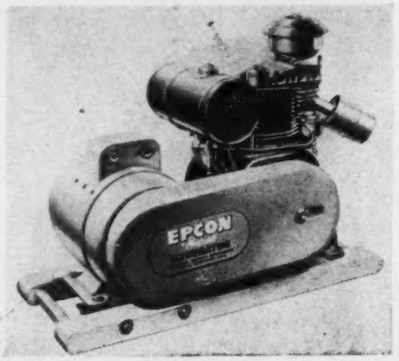
"No. 1900" Castolin eutectic alloy; available in 3/16-in. rods with orange tips; used with No. 1900 Autochemic flux. **Eutectic Welding Alloys Co.**, 40 Worth St., New York, N. Y.

For joining of magnesium sheets to castings, correcting machining errors, filling blowholes or defects, the alloy is stated to have a binding temperature of 960-1,060 deg. F. and tensile strength of 29,000 psi. Welds made with this alloy contain a high amount of magnesium and aluminum and show tensile strength, hardness and corrosion resistance comparable to the parent metal itself, according to the manufacturer.

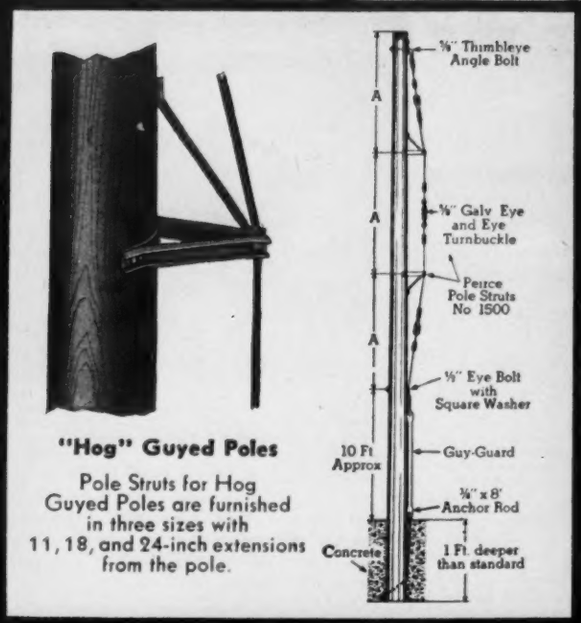
•

A. C. Generator

Portable, air-cooled generating unit has cast-iron fittings to secure both the generator and the Briggs and Stratton engine to oak sled runners which serve as a light base. It has a V-belt drive and pulleys are of cast steel disks. Field ring is annealed cast steel. End bells are open design. Dust covers are light-weight steel spinnings.

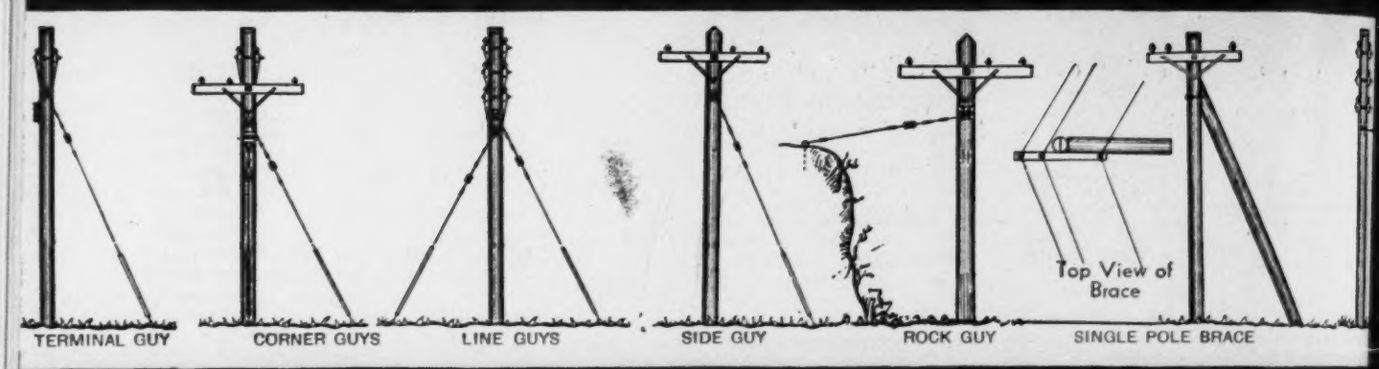


"Type B-30" generating unit; rated 3,000 watts, 110 volts, 60 cycles; net weight 305 lb. **Electrical Products Consolidated**, Seattle, Wash.

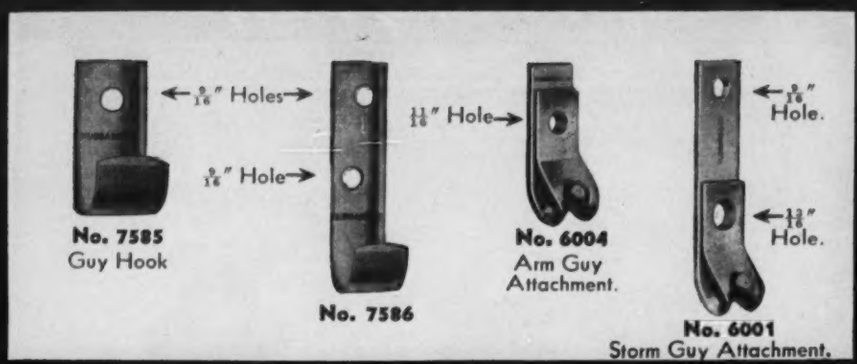

⅝" Thimbleye Angle Bolt
⅝" Galv Eye and Eye Turnbuckle
Peirce Pole Struts No 1500
½" Eye Bolt with Square Washer
10 Ft Approx
Guy-Guard
¾" x 8' Anchor Rod
Concrete
1 Ft. deeper than standard

"Hog" Guyed Poles

Pole Struts for Hog Guyed Poles are furnished in three sizes with 11, 18, and 24-inch extensions from the pole.



"Hang the Load on Hubbard Hardware"



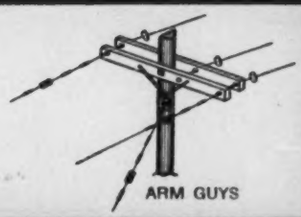
No. 7585
Guy Hook

No. 7586

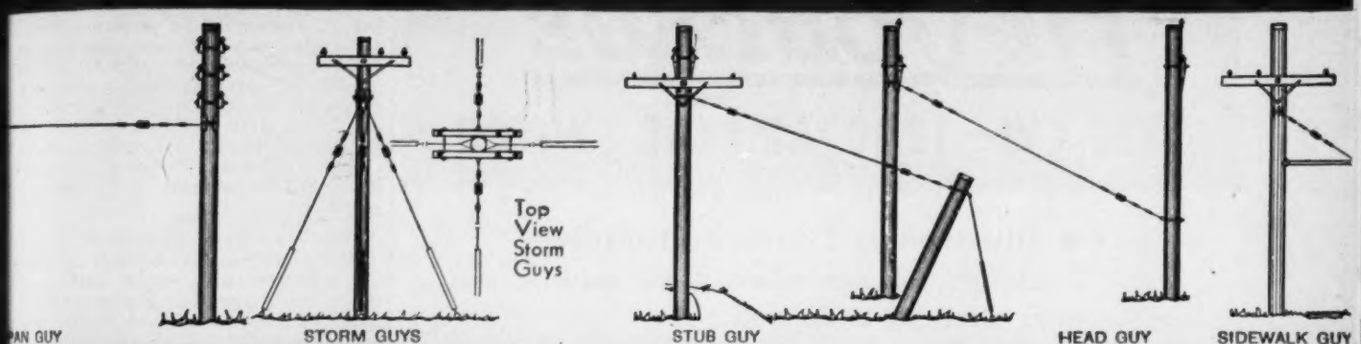
No. 6004
Arm Guy Attachment.

No. 6001
Storm Guy Attachment.

No. 9786 Double Arming Eye Bolt
5/8" and 3/4" Diameter—16" to 20" Lengths.



ARM GUYS



AN GUY

STORM GUYS

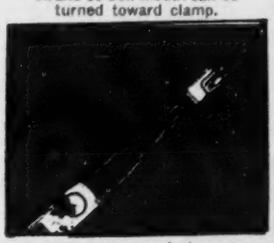
STUB GUY

HEAD GUY

SIDEWALK GUY

No. 7454
Servisleev
Sizes for Strand from 3/16" to 1/2" Diameter

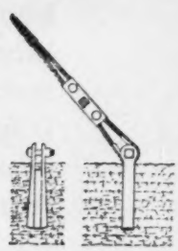
Servisleev is placed over strand so bell mouth can be turned toward clamp.



—Turned toward clamp bell mouth is driven over loose end of strand.

No. 7547 Rock Anchor

Installation of Rock Guy Anchor with Split End and Wedge.



No. 7545
Wedge and Shim Type Rock Guy Anchor.

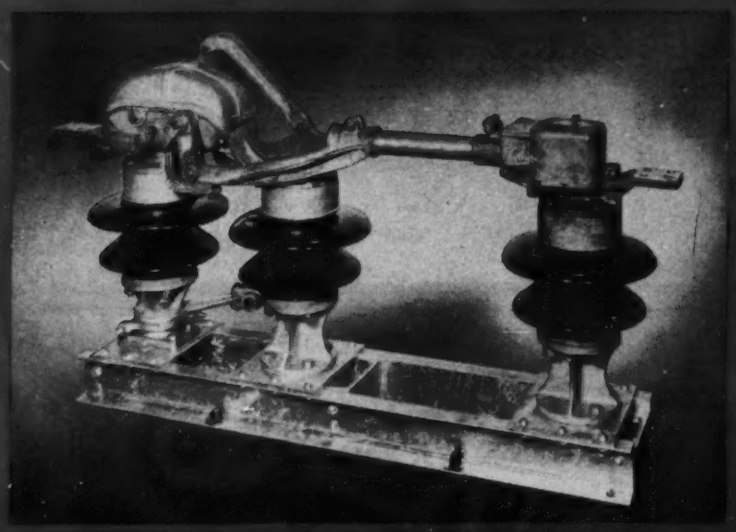
No. 7595
Guy Thimble
Sizes for all standard strand and Anchor Eyes.

HUBBARD

HUBBARD AND COMPANY

PITTSBURGH OAKLAND CALIFORNIA CHICAGO

A RUGGED SWITCH
for Heavy Duty



HI-VOLTAGE
TYPE CW—1200 AMPERE SWITCH

● Illustrating 5 inch bolt circle insulators for use when extra insulator strength is desired.

Built to be mechanically fool-proof and give trouble-free service. Graphite bearings are used throughout. No lubrication is ever required. Entire mechanism is completely housed. Dependable performance is the important factor in switch design. Attractive appearance that will make for better overall station appearance is not to be overlooked in planning for the future.

HI-VOLTAGE
EQUIPMENT COMPANY
2891 East 79th Street — Cleveland 4, Ohio

TECHNICAL LITERATURE

A REPORT ENTITLED "Turbines, Condensers, Feedwater Heaters, 1942," contains data from nine operating companies. This is publication, No. K-7, obtainable from Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y.; price 65 cents to non-members in U. S. A.

SYNTHETIC RUBBER—A chart on the ABC's of synthetic rubber, a brief description of the various types, a simple review of the chemistry of rubber, polymerization, vulcanization, chemical structure of natural and synthetic rubber, are some of the subjects presented in a 32-page publication, "Facts About Synthetic Rubber," available from New York Belting & Packing Co., 1 Market St., Passaic, N. J.

"PROPERTIES OF SOME METALS AND ALLOYS" is an 18-page bulletin listing in tabular form the characteristics, properties and chemical compositions of 104 different metals and alloys, both ferrous and nonferrous. The material list is designed as a guide to substitutes for critical materials. Copy is obtainable from the International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

POWDER METALLURGY—Seven technical papers on subjects such as fundamentals necessary to apply powder metallurgy, effect of pressure on the properties of compacts, effect of particle size, alloy powders, metal powder friction materials, and hot pressing of metal powders, together with discussions on each, are presented in a 60-page publication, "Symposium on Powder Metallurgy," obtainable from American Society for Testing Materials, 260 South Broad St., Philadelphia 2, Pa.; price $1 per copy.

"PIPE AND TUBE BENDING HANDBOOK" covers subjects such as hot and cold bending, minimum radii, temper, bending with use of filler materials, step-by-step procedures for both smooth and wrinkle bending and includes tabular data on tubes as well as chemical and physical properties of pipe material. The well-illustrated handbook is available from Copper and Brass Research Association, 420 Lexington Avenue, New York 17, N. Y.

HEAT MEASUREMENT—A description of the potentiometer method, an explanation of the electronic principle employed in the company's instruments, four operating diagrams, and a table of controller scale ranges obtainable with various thermocouples and a photoelectric pickup unit, are contained in Bulletin A2-3, "Potentiotrol," issued by Wheelco Instruments Co., Harrison and Peoria Sts., Chicago 7, Ill.

LIGHTING—A 175-page "Lighting Handbook" has chapters on lighting terms and measurements, recommended levels of illumination, interior lighting design calculations, interior wiring for lighting, and presents a series of charts for determining the desired illumination for various applications. The manual is available from Westinghouse Lamp Division, Bloomfield, N. J., price $1 per copy.

"POLE TOP RESUSCITATION" is publication K-8 prepared by the Accident Prevention Committee of Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y. This 8-page publication contains general instructions, illustrations and other details concerned with rescue procedure and practices.

NEWS ABOUT PEOPLE

O. J. Miller Joins Duke Power Co.

O. J. Miller, who has been associated with the Commonwealth & Southern Corp. in Jackson, Mich., as assistant supervising engineer in the engineering department since 1940, has resigned to become system operating manager of the Duke Power Co., with headquarters in Charlotte, N. C.

Mr. Miller became identified with the public utility industry in 1916 with E. W. Clark & Co., management corporation, in Columbus, Ohio, where he handled engineering assignments involving design and construction on various proj-

ects. In 1920 he joined the Tennessee Electric Power Co. as engineer in charge of various engineering, operating and construction activities. Four years later he was made superintendent of production, operation and maintenance, and subsequently was appointed manager of the production and transmission department. After the sale of the electric power facilities of this utility, Mr. Miller became manager of the transportation system in Nashville. It was in 1940 that he joined the staff of the Commonwealth & Southern Corp. in Jackson.

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▶ D. Hayes Murphy, president of the Wiremold Co., Hartford, Conn., has been elected treasurer of the Fuller Brush Co., Hartford, succeeding William A. Purtell. Mr. Murphy is a native of Providence, R. I., and was graduated from the University of Wisconsin in 1900. His entire business career has been devoted to the manufacture of surface wiring systems, non-metallic flexible tubing, commercial and industrial lighting equipment. He is a past president of the National Electrical Manufacturers' Association and of the Electrical Manufacturers' Club. For two years he served as chief of the certification section of the OPM; and is a member of the business advisory council of the U. S. Department of Commerce and of the Army Ordnance Association, besides being prominent in banking and philanthropic circles in Connecticut.

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Loiseau Heads Public Service of Colorado

John E. Loiseau, formerly vice-president and secretary of the Public Service Co. of Colorado, has been made president of that utility, succeeding Guy E. Faller, who becomes chairman of the board.

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▶ Casper F. Spolen, for the past nine years assistant secretary of the Connecticut Public Utilities Commission, has become associated with Baker, Cameron, Soby & Penfield, Inc., Hartford advertising agency, as an account executive.

▶ George R. Rice, who was first employed by the Puget Sound Power & Light Co. back in 1921 in Tacoma and for many years connected with the company's interests in the East, has returned to the home offices of the company in Seattle as its new financial and operating analyst.

▶ J. S. Buchsbaum has been appointed sales promotion manager of the Standard Transformer Co., Warren, Ohio. Mr. Buchsbaum was formerly connected with the Ohio Public Service Co., Warren, for 20 years as meter superintendent and service manager.

Kentucky Utility Promotes R. E. Hodges

Richard E. Hodges, formerly assistant general manager of the Kentucky & West Virginia Power Co., Ashland, Ky., has been appointed general manager of the company to succeed M. C. Funk, who has assumed new executive duties with the Appalachian Electric Power

Co. (Electrical World, November 27 page 112).

A native of Alderson, W. Va., and a graduate of the college of engineering at West Virginia University, Mr. Hodges entered the employ of the Appalachian Electric Power Co. at Sprigg, W. Va., as a meterman in 1926. After serving in the new business, substation and power plant departments he was promoted to assistant manager in the Pikeville district of the Kentucky & West Virginia Power Co. and was appointed district manager of that district in 1929. He served in that capacity until 1940, when he became assistant general manager of the company.

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▶ Dean H. Mitchell, president of the Northern Indiana Public Service Co., Hammond, Ind., has been elected president of the Indiana State Chamber of Commerce.

▶ Will T. Clark has been named manager of the residential division of the Cleveland Electric Illuminating Co. In addition to his new work with the Illuminating Company, Mr. Clark will take over some of the duties at the Cleveland Electrical League formerly performed by League President J. E. North. Mr. North is now sales manager of the Illuminating Company. Mr. Clark has been active in the local league since 1936, serving as a member of the speakers' bureau, director of promotional activities before the war, and later as secretary of the league. He has

PEAK-LOADED

FOR THREE YEARS...

READY FOR A REST

HERE'S A CABLE on which a city has depended for light and power. Through three years of pre-war preparedness and war production, it has operated—overloaded—without breakdown!

Credit goes to the plant that made this cable and to the maintenance engineers who "babied" it through this critical time. And let's think, too, of the jobs that will be created when Victory brings the signal to replace such cables and wires all over the nation. Peacetime jobs—in your company and ours.

JOHN A. ROEBLING'S SONS COMPANY

TRENTON 2, NEW JERSEY — *Branches and Warehouses in Principal Cities*

JR ROEBLING

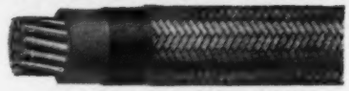
ROEBLING

PACEMAKER IN WIRE PRODUCTS

Wire Rope, Strand, Fittings Division
Aircord Division
Suspension Bridge and Cableways Division
Electrical Wire Division
Round, Flat Wire Division
Woven Wire Fabric Division

WIRES AND CABLES FOR POWER TRANSMISSION AND DISTRIBUTION

Bare Concentric Copper Strands



Rubber-Insulated Power Cable, Braided and Leaded

Roesheath, Non-Metallic Parkway Cable

Roebling Weatherproof Wire and Cable

Roebling Varnished Cambric Insulated Cable

Roebling Tree Wire

Roebling Zinc-Coated Steel Strand

a wide acquaintanceship with members of the electrical industry in Cleveland. Before his connection in Cleveland he spent two years as director of lighting sales for the Pennsylvania Power & Light Co. in Allentown and was connected with both the lamp and plastics division of the General Electric Co.

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Philadelphia Electric Group Elects Officers

Howard L. Miller, electrical contractor, was elected president of the Electrical Association of Philadelphia for 1944 at the recent annual meeting of the board of governors. Mr. Miller, who is president of the Utilities Engineering Co., succeeds A. L. Hallstrom, vice-president of Graybar Electric Co., Inc.

The other officers elected were: vice-president, H. B. Bryans, executive vice-president, Philadelphia Electric Co.; treasurer, Philip H. Ward, Jr., president, Ward Electric Co. and secretary, Robert J. Moran, chief of electrical department, Middle Department Rating Association.

•

▶ GLENN HAYWORTH, superintendent of the Crawfordsville (Ind.) electric light and power plant, has been elected president of the Indiana Municipal Electric Association.

▶ DEAN L. DUTTON, former chief operator at the Oneida plant of the Utah Power & Light Co., has been made superintendent of the Ashton plant at Ashton, Idaho. He replaces D. O. RAWSON who has been made superintndent of the Weber plant.

▶ H. E. D'ANDRADE has become affiliated with the General Electric lamp department's Atlantic District, New York, as a consultant on architectural lighting problems. Mr. D'Andrade began his work with architects in 1928 as chief of the architects service division of the Brooklyn Edison Co. He served as manager of the Brooklyn utility's lighting bureau and also as director of the "Edison Wonder House," an exhibit showing all types of lighting and power applications in the home. Educated in British schools, and at Queens Royal College, Trinidad, B.W.I., he was trained in civil engineering and surveying with the British Government and was granted a license to practice in the British colonies. He joined the illuminating engineering bureau of the Westinghouse Lamp Co. in 1924. His work with public utilities began in 1926 when he became illuminating engineer of the Brooklyn Edison Co. He has been active in the affairs of the Illuminating Eng-

ering Society, having served on several its committees. With the advent of ar, Mr. D'Andrade became senior engi- eer in charge of protective lighting r the Second Civilian Defense Region, CD. His work with State councils, chnical committees and county offi- ials helped to disseminate and sim- ify the technical aspects of war-time ghting problems.

DONALD J. LUTY has been appointed eneral manager of the heating division Gar Wood Industries, Inc., Detroit. r. Luty has been with Gar Wood In- ustries, Inc., for 14 years and was ssistant general manager of the heat- g division for many years. He also eld the title of chief research engineer the company.

JAMES D. CUNNINGHAM, president of epublic Flow Meters Co., Chicago, Ill., as been elected to the board of direc- rs of the Allis-Chalmers Manufactur- g Co. Mr. Cunningham succeeds harles W. Cox of New York, director nce 1913, who resigned because of ill ealth. Mr. Cunningham, who is presi- nt of one of the leading companies in e field of power plant instruments and mbustion control equipment, is also resident of the Autogas Co. and the moot Engineering Co. He is a fellow the American Society of Mechanical ngineers and a member of the Western ociety of Engineers.

O. O. LEWIS, formerly branch man- ger of Fairbanks, Morse & Co., Chi- go, at Atlanta, Ga., has been pro- oted to the position of assistant eneral sales manager of the company. O. HARKNESS, formerly manager of e company's branch at Dallas, Tex., as been appointed manager of the iesel engine sales division, Chicago. N. VAN EPPS, formerly manager of e diesel department, Chicago branch, as been promoted to manager of anch at Atlanta, Ga.

PETER L. LENZ has been appointed anager of the Middle Atlantic district anufacturing and repair department the Westinghouse Electric & Manu- cturing Co. Mr. Lenz, who was for- erly manager of the Homewood man- facturing and repair plant, Pittsburgh, ill make his headquarters in Philadel- hia. His new duties will include gen- al supervision of two manufacturing d repair plants in Philadelphia, one Wilkes-Barre, Pa.; Huntington, W. a., and Baltimore. Born and educated Germany, Mr. Lenz came to this untry in 1924 and early the following ar joined Westinghouse as an engi- er in the small motor division. He rved successively in Pittsburgh as a anufacturing engineer to the works anager's department, manufacturing

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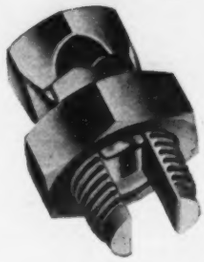

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engineer in the generator division, assistant superintendent in the transportation and generator division and superintendent of the Greensburg generator division. In 1942 he was appointed manager of the Homewood plant. Among other assignments Mr. Lenz was active in the manufacturing of a.c. and d.c. motors and generators, mine and railway locomotive equipment, and in the development of mercury-arc rectifiers and the Ignitron.

▶ J. W. WHITESIDE has been appointed buyer in the tube division of the electronics department, General Electric Co. His headquarters will be at Schenectady. In this capacity he will be responsible for all purchases, including subcontracting, for the division. Mr. Whiteside entered the employ of General Electric Co. in 1929 and subsequently became identified with the International General Electric Co. In 1933 he was sent to China to work for the China General Edison Co. in Shanghai, and later worked for the I.G.E. in Manila and Shanghai. It was in 1941 that he returned to the United States to work for the motor division at River Works, Lynn, Mass., from where he was transferred to his present assignment.

▶ R. F. TUCKER and ADOLPH FRANKEL have been appointed staff assistants to the manager of the Westinghouse Lamp Division, with headquarters at Bloomfield, N. J., Ralph C. Stuart, manager, has announced. In their new positions the two men will assist Mr. Stuart in co-ordination of the manufacturing, engineering and sales activities of the four lamp division plants. Mr. Tucker, who joined Westinghouse in 1909, has been assistant division auditor since 1939. Since joining the company, in 1917, Mr. Frankel, formerly assistant manager of the special products commercial department, has been connected with the sales, advertising and engineering of lamps and electronic tubes.

OBITUARY

▶ RODERICK MCRAE, manager of the Pacific Power & Light Co., at Hood River, Ore., and a civic leader in that community, succumbed to a heart attack on December 8, at the age of 50 years. He was at one time with the Pacific Power company at Lewiston, Idaho, before going to Hood River about 12 years ago.

▶ HOWARD B. SHAW, professor of industrial engineering at North Carolina State College, Raleigh, died in that city on December 15 at the age of 74. He was a member of the Missouri Public Service Commission before transferring his interests to the State of North Carolina.

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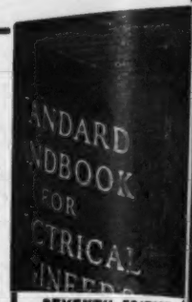

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MANUFACTURING-MARKETS

Ward Harrison Views Post-War Picture

A real market for fluorescent lighting after the war will be the nearly two million stores in the U. S. A., Ward Harrison, director of G. E. lamp department's engineering division, told a group of lamp sales executives at Nela Park, Cleveland. These stores, according to utility executives contacted by Mr. Harrison, are chiefly interested in F-lighting. Incandescents, however, will still have considerable use for spot-lighting.

Chain stores alone, one survey shows, will spend a half billion dollars in the first year after the war for store modernization.

Mr. Harrison pointed to three objectives in the G. E. 3A store-lighting plan: Lighting for attraction, appraisal, and for atmosphere. Of interest to architects and manufacturer of store-front materials is the all-glass "visual store front," which reveals the whole store from the street. To accomplish this, the "visual store front" store will require a relatively great amount of light. Among other markets for greater amounts of fluorescent lighting will be the theater and the gas service station.

Mr. Harrison believes that millions of men and women war workers, aware of the advantages of 25 to 50 ft.-candle levels from the fluorescent systems in their war plants, will not continue to be satisfied with the relatively low levels of lighting in their homes.

More safety and lighting conscious than ever before, many municipalities have already made detailed plans and are setting aside funds for post-war improved street lighting, Mr. Harrison revealed.

•

Allis-Chalmers Issues New Maintenance Magazine

"Allis-Chalmers Operation and Maintenance Review" is a new pocket-sized magazine succeeding Allis-Chalmers' "Victory Production and Maintenance News."

Illustrated with eye-catching color cartoons, the publication aims to broaden interest in problems of wartime maintenance. It contains maaintenance tips from Allis-Chalmers engineers, as well as timely articles on current trends for the shopman and the executive.

•

General Radio Opens New Chicago Office

To assist users of General Radio equipment in the Chicago and Middle West area, the General Radio Co. opened a Chicago engineering office on December 1. The new office is located at 920 South Michigan Avenue.

In charge of this office is Lucius E. Packard, who for the past three years has been in charge of the New York engineering office. Succeeding Mr. Packard at the New York office is Martin A. Gilman of the factory engineering staff. Like Mr. Packard, he has been engaged in both development and commercial engineering work at the factory.

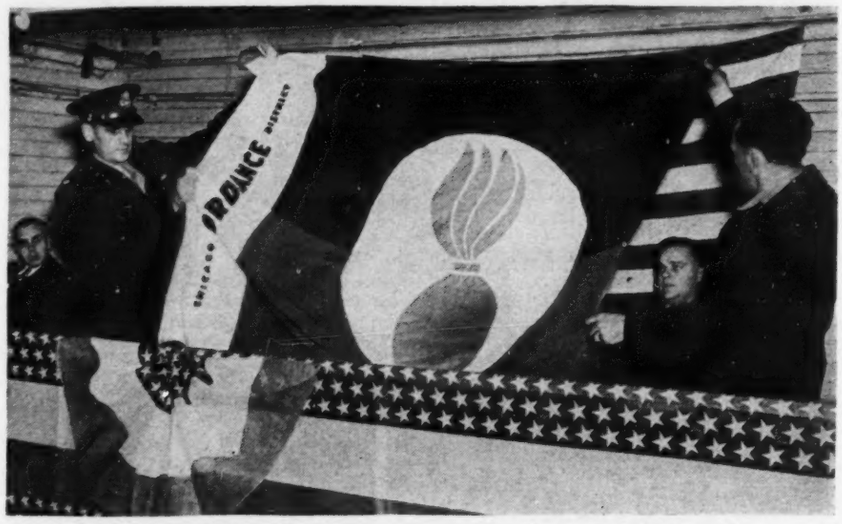
Sees Rapid Growth in Television

With thousands of engineers, technicians, mechanics, carpenters and other skilled laborers required to build television stations and several times that number of people needed to manufacture receivers, there is every reason to believe that television in the post-war period will be a bigger industry than radio ever was, it was predicted by David B. Smith, director of research for Philco Corporation, in a recent address on "Electronics" before the Association of Customers' Brokers.

"In the post-war television set the picture will be larger than most of those available today, and some receivers may provide a picture as large as the average road map," Mr. Smith said. "You will probably have the television set in your living room, and you'll turn the lights down, but not out, when you look at it."

Rapid expansion of television as soon as the war is over will depend upon the creation of networks linking stations together, so that the best entertainment and news programs can be made available to the viewing audience, Mr. Smith pointed out.

"Sound broadcasting entered its period of greatest growth and expansion when network operation got underway, and the same principles will apply to television," Mr. Smith said. "Ultra-high-frequency television relay stations have already been developed by Philco Corporation and other research groups to link television transmitters together,



GETS ORDNANCE BANNER—For meritorious work in the production of 75-mm. shell crates Valentine Clark Corp., St. Paul, Minn., was recently awarded the Army Ordnance Banner. The banner was presented by Lieut-Col. A. V. Stallard, chief of the Twin Cities Regional Office of the Chicago Ordnance District, and was accepted for the company by Kenneth M. Sperry, vice-president. From left to right in the above picture are: J. C. Ellis, Ordnance Department, Lieut.-Col. Stallard, K. M. Sperry, vice-president of the company and Lawrence Martin superintendent of the crate factory

and these are in successful operation today.

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Manufacturers Make Sales Assignments

Electrical manufacturers have recently announced the following appointments to their sales staffs:

Hubbard Co. has appointed Norman V. Arntzen, for the past thirteen years a member of the sales and engineering staffs of the Pacific Coast division, as district sales manager for the company's southern district. Mr. Arntzen will make his headquarters in Los Angeles at the company's local office at 416 West Eighth Street, confining his work to southern California and Arizona.

Gould Storage Battery Corp., Depew, N. Y., has announced the appointment of J. H. Hamilton as sales representative in the San Francisco territory. He will have his offices at 478-421 Flood Building, San Francisco, Calif. Mr. Hamilton was formerly with the National Cash Register Co. as sales agent.

Trico Fuse Manufacturing Co., Milwaukee, has appointed the Southeast Engineering Co., 2056 Post St., Jacksonville 1, Fla., as representative of the complete line of fuses, clamps for fuse clips, fuse pullers, oilers and accessories in the states of Florida, Georgia and Alabama. The line will be represented under the supervision of Frank Gillooly.

Norman M. White has been appointed district operating manager at Graybar-Dallas. J. R. Ernest has been appointed district operating manager at St. Louis and will assume the duties formerly performed by Mr. White.

•

Give Westinghouse Picture

An oil portrait of George Westinghouse was presented last week to Union College, Schenectady, where he once studied for a brief time. The portrait, done by Malcolm Parcell of Washington, Pa., was unveiled at a special assembly in the chapel on the college campus. The portrait was a gift from the Westinghouse Electric & Manufacturing Co.

•

Gives to Post-War Fund

Servel, Inc., has subscribed $50,000 to the Evansville College post-war development program, which calls for $650,000 for new buildings and equipment. The gift is to be applied toward construction of an engineering and science building.

•

Emerson Pays Dividend

Emerson Electric Manufacturing Co. has declared a dividend of 15 cents a share on the common stock, increasing 1943 payments to 50 cents from 35 cents last year.

Field Reports on Business

Reports from the heavy industries are generally favorable, with most quarters showing sizable gains over last year. In the electrical field, manufacturers report wide demand for wiring supplies. Favorable weather and night openings gave impetus to Christmas buying.

PACIFIC COAST

Bonneville is receiving bids on 73 miles of 230 kv. line No. 2 between Covington and Grand Coulee. Manufacturers report larger orders for fractional horsepower motors, such as one shipment of 1,590 costing $30,000, and another of $40,000 of pressure pump motors. The prolonged dry spell in northern and central California which is causing concern, would normally result in considerable pumping motor business and may yet do so.

Pacific Gas & Electric Co. has purchased three 230 kv. circuit breakers, costing with supplies about $160,000. The Shadow Mt. Dam, a unit, near Granby, of Colorado-Big Thompson project, has been contracted for $440,740. Oakland has approved a post-war expenditure of $70,000 for night sports lighting of parks.

A 250-ton capacity tungsten mine near Mill City, Nev., will be partially re-built and re-equipped.

Typical of greatly increased capacity installations now being constructed throughout the West is a San Francisco planing mill with capacity of 12 carloads a day, compared with previous largest capacity of one carload.

Treasure Island Naval training station is to be doubled in size with increased demand of 1,600 kw. General Electric is setting up a special repair and testing shop in San Francisco for Navy auxiliary motors as large as 100 hp. a.c. and 25 hp. d.c. Army is building a second cold storage plant and warehouse in Bay area, with estimated demand of 1,000 kva. An auxiliary naval air station, costing $1,108,200, will be constructed in Nevada.

NEW YORK

Sales of New York City department stores showed a decrease of 7 percent in the week ended December 11, compared with the like week a year ago, according to the report issued last week by the Federal Reserve Bank of New York. Specialty store sales, however, increased 5 percent in the week. Throughout the nation department store sales were 1 percent under the corresponding week a year ago, according to the Federal Reserve Board. In the preceding week such sales were 7 percent ahead of the like period in 1942, while the four weeks ended December 11 showed a 9 percent increase over the corresponding four weeks last year.

Merchants and businessmen here received a bit of good news out of Washington this week when the WPB authorized the production of 269,809 non-mechanical refrigerators in the first quarter of 1944 and Donald Nelson stated that limitations on the production of civilian goods will be lifted "as quickly as it is found feasible to do so."

Civil engineering construction volume in continental U. S., according to the *Engineering News-Record*, totaled $26,792,000, 65 percent lower than the total for the corresponding week in 1942 and 23 percent lower than the $34,652,000 reported for the preceding week. Current week's volume brings the 1943 construction total to $2,999,009,000, which is 67 percent under the $9,196,157,000 for the 51-week 1942 period.

NEW ENGLAND

New England continues to receive DFC allocations for plant equipment needed for war materials production; supplies for lighting installations are in greater demand; a number of smaller shipyards are turning toward production of fishing vessels and will be in line soon for special lines of electric apparatus and, despite lessening in work hours in some plants and slowing down of contract awards, New England manufacturers of electrical equipment are submitting bids in good numbers.

Split Ballbearing Corp., Lebanon, N. H., has received an allocation of $125,000 for new equipment for war production. Public Service of New Hampshire is expending $25,000 for transmission facilities in the Peterborough, N. H., area, and new lighting systems costing approximately $20,000 will be installed in two New England Army airports by Anderson & Coffey Co., Boston.

A new fire station, costing $12,840, to be erected by Joseph Bennet Co., Boston, in western Massachusetts, may be the forerunner of much needed construction in this class of structure, which should encourage sales of wiring and communication apparatus.

Massachusetts manufacturers have submitted bids on 33,000 rolls of friction tape, 450 safety switches, a large group of electric lanterns, oil filter condensers, vacuum tube voltmeters and a large amount of wiring supplies. Small motor sales have declined among machine tool builders, but are steady and very promising for post-war modernization in the textile industry.

CHICAGO

Recent announcement of a $1,449,000 construction budget for 1944 has been made by Wisconsin Public Service Corp., Green Bay, of which $1,333,927 is for new projects. About $300,000 is to be spent for rural line construction and $371,000 for two projected interconnection projects, for which WPB authorization is to be sought.

Priorities have recently been granted to Wisconsin Electric Power Co., Milwaukee, for the construction in 1944 of a 23-mile single-circuit, 132-kv., wood-pole, H-frame transmission line from Port Washington station to Granville substation northwest of Milwaukee. A portion of the line is to be built using copper transmission cable which the company has in stock. The balance is to be built with aluminum conductor, for which priorities have been granted by the WPB in Washington.

International Harvester Co. this week announced the purchase of 375 acres of land between Alton and Wood River, Ill., for the construction of a post-war machinery plant, which will employ 3,500. Present plans call for a single-story plant, including a foundry, forge shop, machine shop, warehouse and central heating facilities.

Retail sales in department stores of the Seventh Federal Reserve District were generally off for the week ended December 11, compared with the same week last year. Chicago was down 5 percent.

During the week ended December 9 63 Chicago area firms received a total of 84 war orders, totaling $5,864,000.

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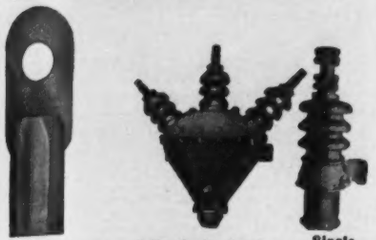

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Sales Opportunities

WASHINGTON—Puget Sound Power & Light Co., Seattle, is arranging fund of about $1,500,000, for expansion and improvements in properties during 1944, majority to be used for extensions and replacements in transmission and distributing lines, power substations and auxiliary operating facilities. This amount is approximately one-half of that expended for similar work during past year.

NEW YORK—American Locomotive Co., 30 Church St., New York, will carry out expansion in plant for production for government, including installation of machinery and electrical equipment. Cost estimated about $400,000, with financing by Defense Plant Corp. Work is scheduled to begin soon.

TENNESSEE—Utility Service Corp., Nashville, plans installation of motor-driven pumping machinery, controls and auxiliary equipment in proposed new pumping station for water system. Bond issue of $275,000, has been authorized for this and new filtration plant. Proposed to carry out work at early date.

WISCONSIN — Municipal Light Department, Richland Center, has authorized surveys and estimates of cost for proposed expansion in municipal power plant, including installation of new turbine-generator and accessories, boiler and auxiliary equipment. It is understood that project will be a post-war development. Ralph D. Thomas & Associates, 1200 Second Ave. South, Minneapolis, Minn., are consulting engineers.

FLORIDA—Navy Department, Washington, D. C., plans extension and improvements in naval air base, comprising shops, warehouses and other structures, with mechanical and electrical equipment. Also increase in power substation facilities for required larger demand, estimated to cost about $100,000; and for extensions in distribution system, estimated at $50,000. Entire project will cost about $665,000, and fund in that amount is being arranged. Bureau of Yards and Docks, Navy Department, Washington, will be in charge.

NEW YORK—General Motors Corp., General Motors Building, Detroit, Mich., has contracted with government for expansion in plants in New York, New Jersey and Maryland, with installation of machinery and electrical equipment. Cost estimated about $276,000, with financing by Defense Plant Corp. Work will be carried out at early date.

CALIFORNIA—Public Works Department, Long Beach, is arranging a post-war expansion and improvement program for street-lighting system, including installation of ornamental standards and pendant luminaires, with underground and overhead feeder lines and other operating facilities. Project will cover a number of streets and is estimated to cost about $840,000. George E. Baker is city engineer.

VIRGINIA—Bureau of Yards and Docks, Navy Department, Washington, D. C., plans new hangar with shop facilities, mechanical and electrical equipment at naval air station, to replace structures recently destroyed by fire. Cost estimated about $1,700,000. Work is scheduled to begin at early date.

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OHIO—Stauffer Chemical Co., 420 Lexington Ave., New York, N. Y., plans new plant for production for government, comprising several large one and multi-story buildings, with boiler house, power substation, storage and distributing buildings, and auxiliary structures. Cost estimated about $800,000, with financing by Defense Plant Corp. General contract for design and erection has been awarded to Brown & Matthews, Inc., 122 East 42nd St., New York, engineer and contractor.

TEXAS—Central Power & Light Co., Corpus Christi, plans new one-story equipment storage and distributing building, reported to cost close to $50,000.

IOWA—Iowa Public Service Co., Sioux City, plans extensions in transmission line. Application has been made for permission and work is scheduled to begin soon.

ILLINOIS — International Harvester Co., 180 North Michigan Ave., Chicago, has acquired tract of about 375 acres of land on Mississippi River, as site for new plant, to be carried out as a post-war project. It will consist of several one-story buildings, with machinery and electrical equipment for large output. Also storage and distributing structures, administration building, power substation, steam power plant for central-heating service, and other facilities. Cost reported over $1,500,000.

WISCONSIN—Marathon Paper Co., Rothschild, has engaged Ralph D. Thomas & Associates, 1200 Second Ave. South, Minneapolis, Minn., consulting engineers, to make surveys and estimates of cost for extensions and improvements in power equipment and facilities at mill.

ALABAMA — Water Department, Huntsville, plans pumping plant in connection with extensions and improvements in waterworks, including installation of motor-driven pumping machinery, controls and auxiliary equipment. Work will include new filtration plant and storage facilities, and is estimated to cost approximately $300,000. Polglaze & Basenberg, First National Bank Building, Birmingham, are consulting engineers.

TEXAS—J. S. Abercrombie Co., and Harrison Oil Co., Gulf Building, Houston, affiliated interests, will carry out expansion in an oil refining plant for increased production of 100-octane gasoline for aviation service for government, with installation of machinery and electrical equipment. Cost estimated about $4,000,000, with financing by Defense Plant Corp. Proposed to begin work soon.

IOWA—Central States Electric Co., Cedar Rapids, plans extensions in transmission line. Application has been made for permission and hearing will be held soon. No estimate of cost announced.

CALIFORNIA — City Council, Newport Beach, plans extensions and improvements in water system as a post-war project, including new pumping station with motor-driven pumping machinery, controls and accessories. Cost estimated about $120,000. Richard L. Patterson is city engineer.

NEW YORK—Cheplin Biological Laboratories, Inc., 491 West Taylor St., Syracuse, manufacturer of drugs and chemical products, will carry out expansion in plant for production for government, with installation of mechanical and electrical equipment. Cost about $300,000, with financing by Defense Plant Corp. Proposed to begin work soon.

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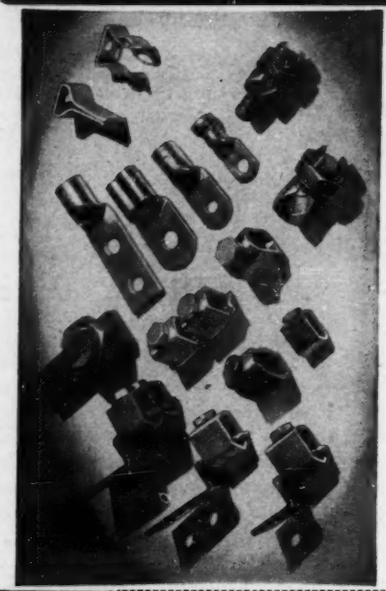

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REA Announces New Allotments

The Department of Agriculture recently announced Rural Electrification Administration allotments totaling $1,610,000 to sixteen co-operatives in nine states. The funds, loaned in conformity with WPB authorization and regulation, will be used, according to Administrator Harry Slattery, for acquisition and rehabilitation of existing facilities and for the extension of electric service to nearby farms meeting WPB standards outlined in the increased food production program.

REA allotments now total $473,150,973, of which $6,202,678 represents operations during the current fiscal year.

Among the allotments are the following:

COLORADO—Southeast Colorado Power Association, La Junta, $880,000; San Miguel Power Association, Inc., Nucla, $8,000.

ILLINOIS—Menard Electric Co-operative, Petersburg, $60,000; Rural Electric Convenience Co-op. Co., Divernon, $50,000.

KANSAS—Ark Valley Electric Co-operative Association, Hutchison, $20,000.

KENTUCKY—Warren Rural Electric Co-operative Corporation, Bowling Green, $131,000.

MISSOURI—Missouri Rural Electric Co-operative Association, Palmyra, $15,000.

NEBRASKA—Dawson County Public Power District, Lexington, $70,000.

NEW MEXICO—Central Valley Electric Co-operative, Inc., Artesia, $6,000.

TEXAS—Coleman County Electric Co-operative, Inc., Coleman, $75,000; Erath County Electric Co-operative Association, Stephenville, $75,000; Belfalls Electric Co-operative, Inc., Rosebud, $25,000; Wise Electric Co-operative, Inc., Decatur, $20,000.

WISCONSIN—Oconto Electric Co-operative, Oconto Falls, $80,000; Barron County Electric Co-operative, Barron, $55,000; Adams-Marquette Electric Co-operative, Friendship, $40,000.

•

Arkansas Power Co. Wins Utility Lease

Arkansas Department of Public Utilities has approved application of the Arkansas Power & Light Co., to lease for 35 years the electric generating and distribution system of the Arkansas Utilities Co. serving the cities of Helena, West Helena and Marianna. The lease provides for purchase of the properties for $1,300,000 after ten years.

Plans call for connecting the Helena-West Helena-Marianna system into the Arkansas Power & Light Co. system as soon as priorities will permit construction of a transmission line, President C. H. Moses of A. P. & L. said. The three cities are now served by a 5,000-kw. plant at Helena, with a 13,000-volt line extending to Marianna. Lease rental will be $120,000 a year.

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POSITIONS WANTED

ENGINEER-EXECUTIVE, 40, good health, graduate E. E., 20 years experience in public utility operation, engineering and construction, offers his services as operating executive or assistant. Has held administrative positions for 12 years with excellent employee relationship record. Location immaterial. Opportunity primary consideration. PW-626, Electrical World, 330 W. 42nd St., New York 18, N. Y.

ELECTRICAL MAINTENANCE MAN 34, technical education, studied Safety Engineering, 13 years in chemical industry in electrical maintenance with some construction experience. At present head of maintenance crew of seven. Desires opportunity for wider use of ability. Available reasonable notice. Assoc. A.I.E.E. PW-627, Electrical World, 330 W. 42nd St., New York 18, N. Y.

WANTED

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D C MOTORS

HP	Make	Type	Volts	Speed
1250	G.E.	MPC	550	130
800	G.E.	MPC	660	600
625	G.E.	MPC	500	130
600	G.E.	MPC	600	650/900
600	Whse.		260	150/275
600	G.E.	MPC	230	450
350	G.E.	DMC	230	400/600
300	G.E.	MPC	230	275/550
300	Whse.		500	250/400
270	Al. Ch.		230	525
200	Whse.		230	400
175	Whse.	SK	260	150/525
150	G.E.	RC-19A	230	800/1000
150	Whse.	SK-201	230	300/900
150	G.E.	MPC	230	250/450
150	G.E.	CO-1833	230	625
125	Whse.	SK-150	230	720
120	G.E.	LC-50	230	1200
100	Al. Ch.		230	950/1150
100	G.E.	MPC	230	225/450
100	G.E.	RC-19	230	575/720
75	G.E.	LC	230	500/1000
75	Whse.	SK-183	230	550/1100
60	El. Dy.	28S	230	525/1050
50/60	Cr. Wh.	65H	230	500/1000
50	Cr. Wh.	CMC-81H	230	300/900

TRANSFORMERS

KVA	Make	PH Type	Voltages
1667	Pitts	1 OISC	13200x2300
1050	G.E.	3 WCTH	11000x445
600	G.E.	3 HT-OISC	11550x2200
333	Moloney	1 C-OISC	22000/11000x2300/575
333	Whse.	1 OISC	2300x460
333	Pitts.	1 OISC	2400x220
300	G.E.	1 H-RP	13200x575/1150/2300
300	Pitts.	3 ODSC	4150x208/120
300	Packard	1 OISC	2200x220/440
200	G.E.	1 H-LDD	26400x115/460
200	G.E.	1 H-OISC	2300x115/230

MOTOR GENERATOR SETS

3 ph. 60 cycle

1—1000 KW GE 600 V. Gen. d.c. to 1400 HP ATI 2300/4000 V. Syn. with Exciter.
1—1000 KW Whse. 600 V. Gen. d.c. to 1400 HP 4000 V. Syn.
1—500 KW GE 600 V. DC Gen. d.c. to 700 HP—2300/13200 V. Syn. Motor with Exciter.
1—400 KW G. E. 250/275 V. Gen. to 700 HP ATI 440/2300/4000 V. Motor.
1—300 KW G. E. 250 V. Gen. to 400 KVA 440 V.
2—100 KW Whse. SK 250 V. Gen. to 150 HP Syn. 2300 V. 900 RPM motor with excit.
1—75 KW G. E. 125 V. Gen. to 120 HP IK 4000/2300 V. motor.

TURBO GENERATOR SET

1—500 KW, Whse. 625 Kva., 440 V., 3 ph., 60 cy., 3600 RPM with Parsons 145/175 lb. condensing turbine complete with jet condenser and accessories.

ROTARY CONVERTERS

60 cycle

	KW	Make	Speed	D.C. Volt	Trans. Volts
1—	1500	Whse.	720	600	2300
1—	1500	Whse.	600	600	11500
1—	1250	G.E.	720	250	2300
1—	1000	G.E.	900	600	13200
1—	1000	Whse.	900	600	11000
2—	750	G.E.	1200	600	2300
1—	750	Whse.	720	250	6600/2300
1—	500	Whse.	1200	600	13200/2300
2—	375	G.E.	1200	250	6600/2300
3—	300	G.E.	1200	600	2300

25 cycle

2—	1500	G.E.	500	225/275	13200/6600
1—	500	G.E.	750	225/275	13200/6600

All units can be furnished with AC and DC controls.

A. C. MOTORS

3 ph. 60 cycle

Synchronous

	HP	Make	Type	Volts	Speed
1—	500	G.E.	TS	440	360
1—	250	G.E.	ATI	220	450
1—	225	G.E.	ATI	240	600
1—	220	Whse.		440	514
1—	150	Al. Ch.		2300	900
1—	150	Whse.	G	2300	900
1—	150	Whse.		2200/550	1800
2—	100	Whse.	G	2200	1800

Slip Ring

1—	1200	Cr-Wh.	801-Q	2200	257
1—	800	Whse.	CW	440	357
1—	800	Al. Ch.		440	885
1—	600	G.E.	IM	440	900
1—	450	Whse.	CW	2200	875
1—	400	G.E.	MT	550/440	300
1—	400	Al. Ch.		2300	505
1—	350	G.E.	IM	2300/4000	257
1—	300	Whse.	CW	440	585
1—	300	G.E.	IM	440	720
2—	250	G.E.	MT	440	450
1—	250	G.E.	MT	4000/2300	257
2—	200	G.E.	IE-M	2200	1750
2—	200	Whse.	CW	2200	514
1—	200	G.E.	IM	440	600

Squirrel Cage

1—	500	G.E.	1-17B	2200	885
1—	400	Whse.	CS-1104A	2200	585
1—	300	Whse.	CS	550	550
1—	300	G.E.	IK	2300	600
1—	250	Al. Ch.		220/440	1150

SYNCHRONOUS CONDENSERS

1—	1000	G.E.	ATI	2200/3800	900
1—	750	G.E.	ATI	220/440	900
1—	600	G.E.	ATI	220/440	900

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MOTOR—3 PHASE 60 CYCLE

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—400 HP, 514 RPM, 440 volt, Westg., slip ring
—335 HP, 600 RPM, 2300 volt, G.E. syn.
—500 HP, 900 RPM, 440 volt, Lincoln slip ring.
—250 HP, 514 RPM, 4000 volt, G.E., syn.
—250 HP, 400 RPM, 4000 volt, G.E., syns.
—200 HP, 600 RPM, 2300 volt, G.E., sl. rg.
—200 HP, 450 RPM, 2200/4000 v. G.E., sl. rg.
—150 HP, 1800 RPM, 440 volts, G.E., sq. cg.
—150 HP, 900 RPM, 440 volt, Al. Ch. sl. rg.
— 75 HP, 1200 RPM, 2300 volt, G.E., vertical.

MOTORS—D. C. 230 VOLTS

—450 HP, 400 RPM, General Electric MPL.
—250 HP, 740 RPM, Electro Dynamic.
—150 HP, 550 RPM, Westinghouse, SK.
—150 HP, 750 RPM, Electro Dynamic.
—125 HP, 600 RPM, Westinghouse, SK.
—100 HP, G.E., 575 RPM.
—100 HP, 420 RPM, G.E.
— 65 HP, 1000 RPM, G.E., type RC.
— 50 HP, RPM, Westinghouse, type SK.

TRANSFORMERS

—400 KVA, G.E., 4156-240/480 v. Scott taps.
—300 KVA, Pittsburgh, 7800/440 volts.
—200 KVA, G.E., 2200-220/440 volts.
—200 KVA Allis-Chalmers, 2200/220/440
—150 KVA, G.E., 22,000 2300/4000 Y.
—100 KVA, Westinghouse, 11,450/250 volts.
—100 KVA, G.E., 2200-220/110 volts.
—100 KVA, Pittsburgh, 1375/2750-110/220 volts.
—100 KVA, Westinghouse, 13200 250 volts.
—100 KVA Allis-Chalmers, 2200/220/110
—100 KVA Allis-Chalmers, 2400/4150Y-2400
—75 KVA, General Electric 2300/220/440.

MOTORS GENERATOR SETS

1—750 KW, 250 volt, Allis Chalmers, synchronous.
1—75 KW, 125 volt, General Electric, squirrel cage
1—6 KW, 125 volt, General Electric, squirrel cage

MOTORS—VARIABLE SPEED 230 VOLTS

1—150 HP, 350/1050 RPM, Crocker-Wheeler.
1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 525/1575 RPM, Electric Dynamic.
1—35 HP, 500/15000 RPM, Westinghouse.
1—35 HP, 250/1050 RPM, Electric Dynamic.
1—30 HP, 225/900 RPM, Crocker-Wheeler.
2—25 HP, 300/900 RPM, Electro Dynamic.
1—20 HP, 750/1500 RPM, General Electric.
1—13/18 HP, 350/1200 RPM, Electro Dynamic.
1—6 HP, 600/1200 RPM, General Electric.
1—5 HP, 450/1800 RPM, Crocker-Wheeler.

ALTERNATORS

1—625 KVA, 3600 RPM, 600 volt, G.E.
1—250 KVA, 720 RPM, 230 volt, G.E.
1—225 KVA, 514 RPM, 600 volt, Westinghouse.
1—200 KVA, 3600 RPM, 240 volt, Allis Chal.
1—62½ KVA, 3600 RPM, 220 volt, Allis Chalmers.

TURBO-GENERATORS

600 KW, Terry dual bleeder condensing Turbine only.
1—600 KW, G.E., 3 ph., 60 cy., 480 volt, bleeder
1—375 KVA, Westinghouse, non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 volt, cond.
1—200 KW, G.E., 3 ph., 60 cy., 220 volt, cond.

ENGINE GENERATOR SETS

1—150 KVA, General Electric Generator, Ames Uniflow engine.
1—62½ KVA, Westinghouse Generator, Fairbanks company engine.

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★ **These companies have supplied additional buying information on their products in the 1943 edition of the Electrical Buyers' Reference**

Truck Mounting Details

IN I-T-E DRAWOUT SWITCHGEAR

Features identified in this cutaway view show I-T-E design working in the interest of the switchgear purchaser. They are typical of the I-T-E approach to the making of switchgear; they promote safety, convenience and long life—and reduce maintenance. Other arrangements that would "work" might be devised but they would not be "I-T-E" unless they also protected the user's investment.

For more details on the features of I-T-E drawout switchgear, send for Bulletin 4207—"Multumite Switchgear Assemblies, Drawout Type."

(1) **LARGE AIR CIRCUIT BREAKER**—To save handling time, drawout type breakers rated 2000 amperes and above are mounted in trucks.

(2) **PRIMARY DISCONNECTING DEVICES**—Safe inspection, away from live parts, is provided by mounting the self-aligning fingers on the truck. Silver surfaces prevent overheating.

(3) **SECONDARY DISCONNECTING DEVICES**—For control and other small wiring. Silver-surfaced contacts are closed at Test Position.

(4) **ELECTRIC OPERATING MECHANISM**—Dependable operation and low current demand are attained with this trip-free, solenoid mechanism.

(5) **SILVER-SURFACED BUSES**—Silver gives lasting immunity from overheating at the joints.

(6) **CONTROL WIRING CONDUIT**—Connects to covered terminal box.

(7) **PROTECTION SHEET**—Covers live contacts when truck is withdrawn from housing.

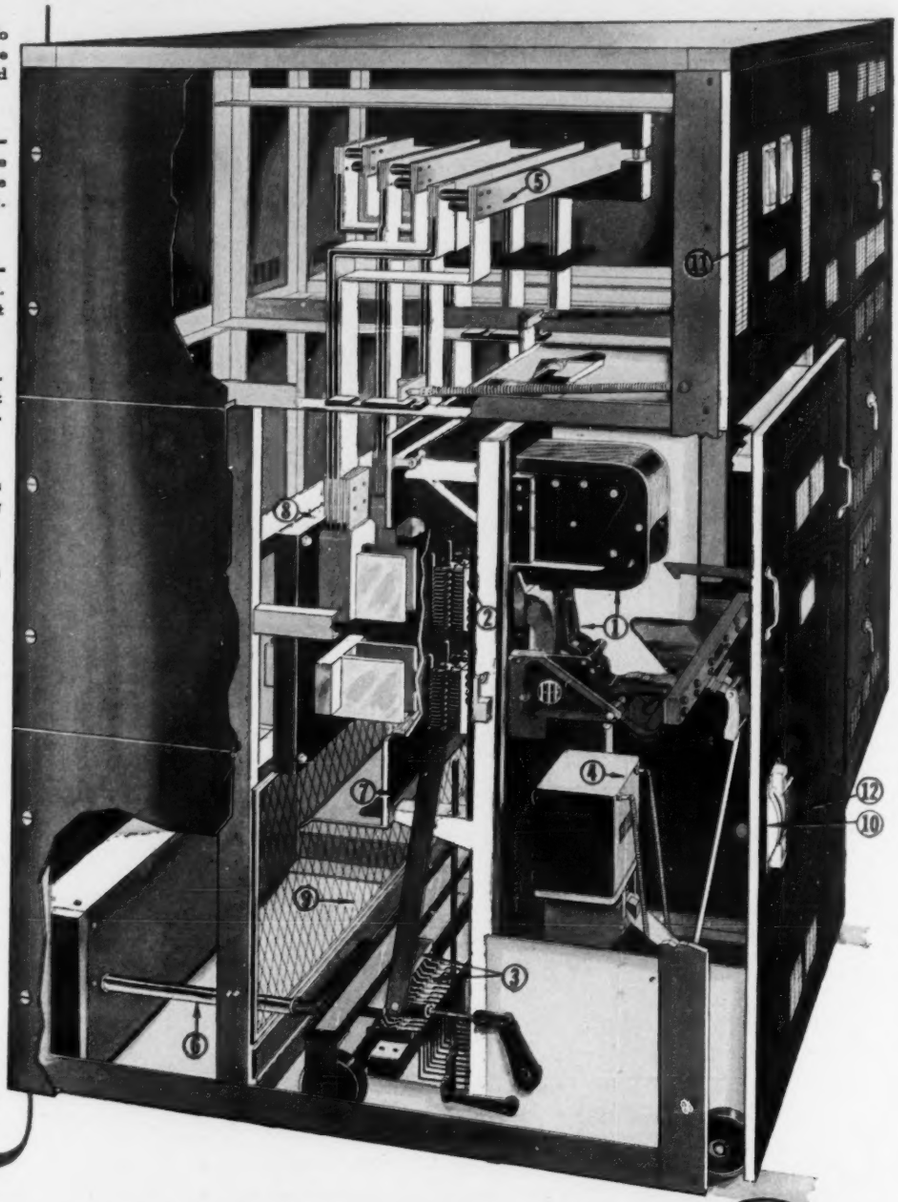
(8) **MALE DISCONNECTING-DEVICE BASE.**

(9) **SAFETY SCREEN.**

(10) **POSITION-INDICATOR HOUSING** — Also encloses trip and reversing linkage handle, and socket for drawout lever.

(11) **HINGED INSTRUMENT PANEL**—Provides ample space for instruments, meters, transfer switches and test blocks.

(12) **HINGED DOOR**—Gives free access to circuit breaker and operating mechanism for inspection and testing. Door may be opened without taking breaker out of service.



I-T-E

AIR SWITCHGEAR

IMMERSED IN AIR • ENCASED IN STEEL

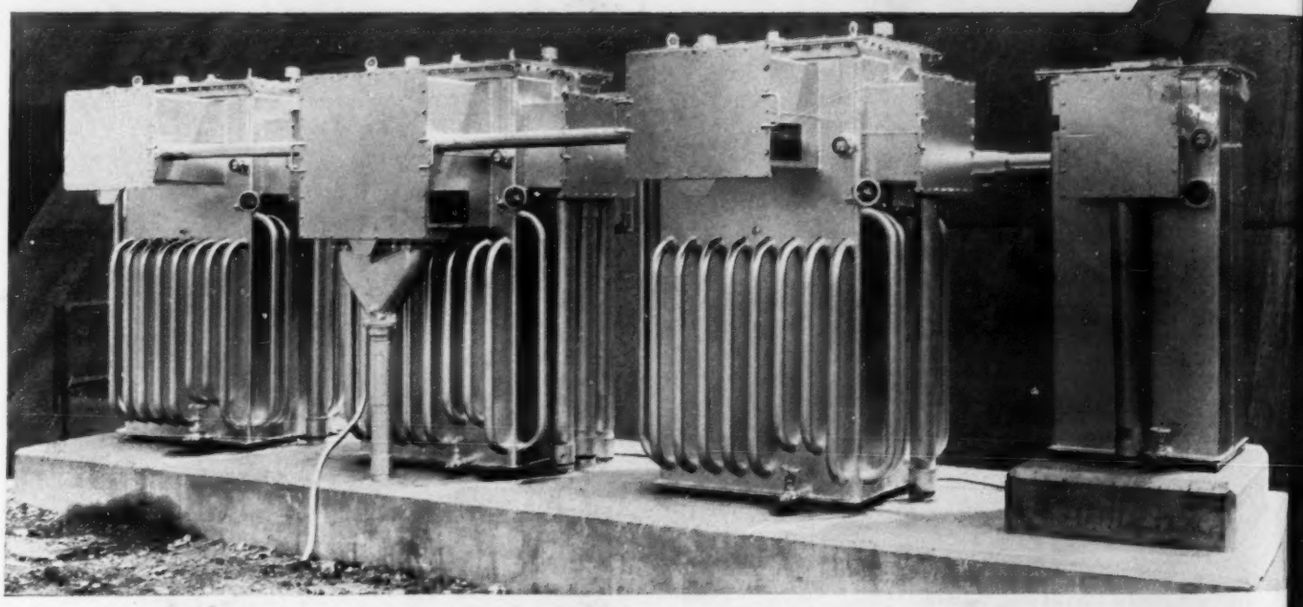
I-T-E

CIRCUIT BREAKER CO., PHILADELPHIA 30, PA.

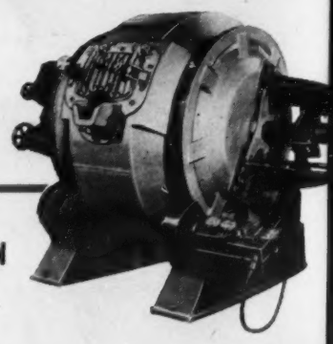
KUHLMAN TRANSFORMERS

STURDY • DEPENDABLE • EFFICIENT

From dam sites and power plants to manufacturing plants and homes, Kuhlman Transformers are transforming electrical energy efficiently day after day with a minimum of maintenance. Shown here is a bank of three—200 Kva, 60 cycle, single phase O. I. S C. Kuhlman Transformers 13800—7200/12470 Y volts with tertiary for 480/240 volts and one—100 Kva, 60 cycle, single phase O. I. S. C. Kuhlman Transformer 480-120/240 volts handling a part of the load from one of America's newer dams. For Power or Distribution Transformers (Saf-T-Kuhl, O. I. S. C., C. S. P. and Dry Type) or Line Regulators it will pay you to get facts and prices from Kuhlman.



In addition to transformers the Kuhlman Electric Co. also manufactures Detroit Rocking Electric Furnaces—a load building, revenue producing product. Using electricity rather than fuel, these fast melting, efficient furnaces are speeding up the production of essential war needs in ferrous and non-ferrous foundries and casting shops.



KUHLMAN ELECTRIC CO., BAY CITY, MICHIGAN